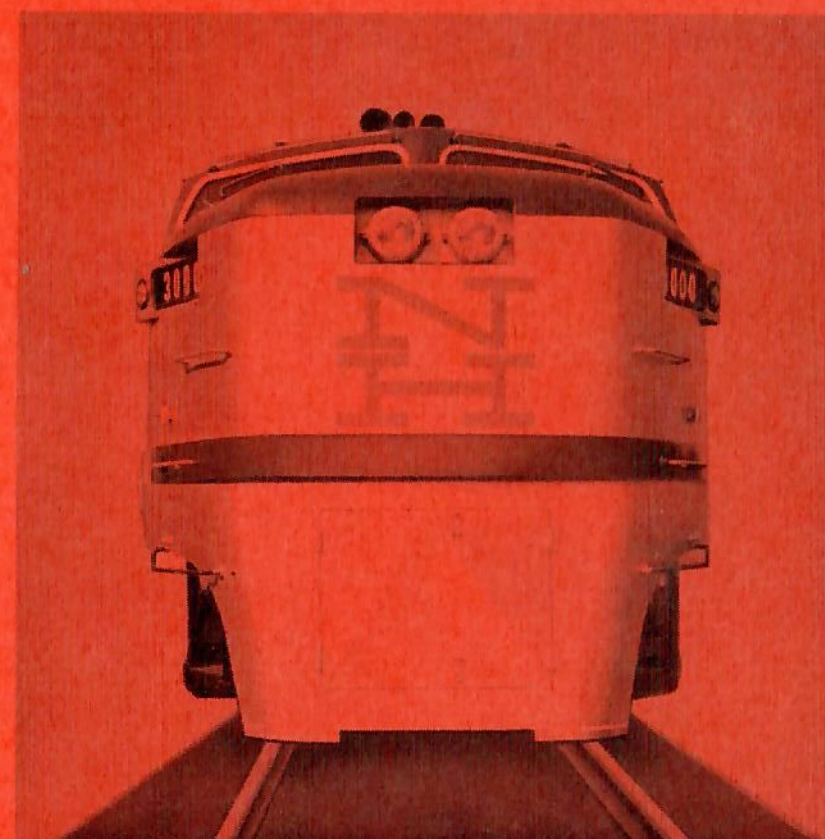




OPERATOR'S MANUAL

No. DHP-2a

**BALDWIN-MECHYDRO
1000 H.P. DIESEL HYDRAULIC
PROPULSION UNIT**



**THE NEW YORK, NEW HAVEN AND HARTFORD
RAILROAD COMPANY**

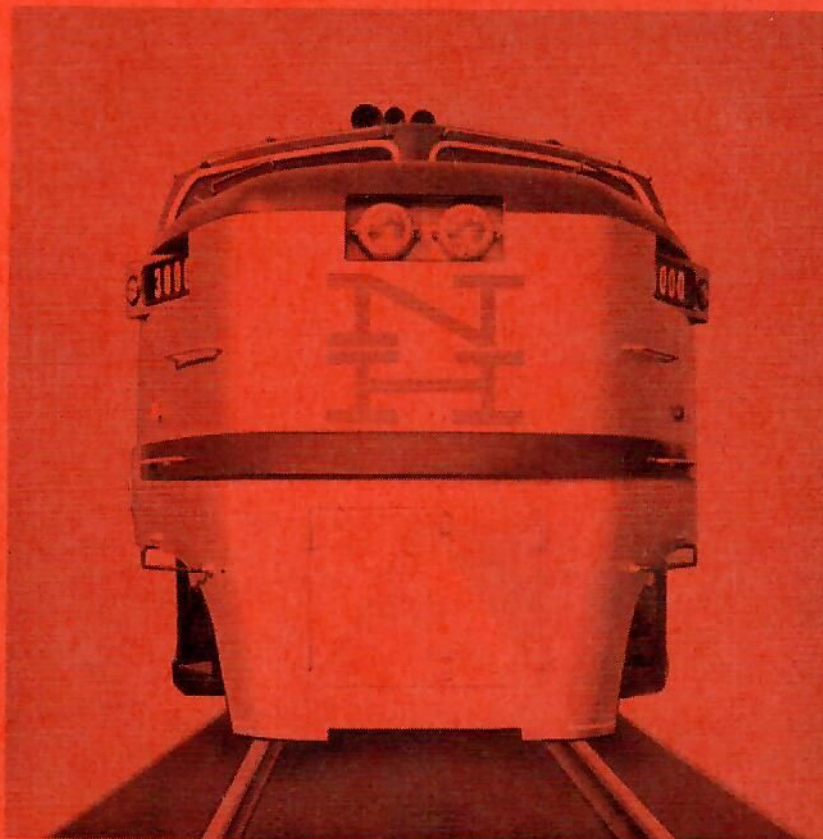
**BALDWIN-LIMA-HAMILTON CORPORATION
PHILADELPHIA, PA.**



OPERATOR'S MANUAL

No. DHP-2a

**BALDWIN-MECHYDRO
1000 H.P. DIESEL HYDRAULIC
PROPULSION UNIT**



**THE NEW YORK, NEW HAVEN AND HARTFORD
RAILROAD COMPANY**

**BALDWIN-LIMA-HAMILTON CORPORATION
PHILADELPHIA, PA.**



OPERATOR'S MANUAL

No. DHP-2a

**BALDWIN-MECHYDRO
1000 H.P. DIESEL HYDRAULIC
PROPULSION UNIT**

THE "DAN'L WEBSTER"

**THE NEW YORK, NEW HAVEN AND HARTFORD
RAILROAD COMPANY**

**CLASS
EDER-6**

**BALDWIN-LIMA-HAMILTON CORPORATION
PHILADELPHIA, PA.**

PREFACE

A new train has been built to operate over your railroad. It has been designed to give better passenger service than ever before. Every employee whose duties affect this service should be thoroughly familiar with the equipment, and make every possible effort to render a service which will attract a larger volume of passenger traffic.

Light weight and low center of gravity are outstanding features of the train. It is intended to render attractive service at low costs and higher speeds. Many new features are built into the train. The propulsion unit has been specifically designed for this new operation and provides head-end power for the cars. However, the designated duties of crew members continue to be related to their respective portions of the train, and details of equipment on cars connected to the power supply will be omitted from this book.

This manual describes the normal operation of the propulsion unit and its auxiliary equipment. Certain service procedures in terminals and on the road are included when they pertain more to operation than to maintenance, but regular maintenance operations are omitted. The recommendations of this book should be carefully followed to obtain dependable service under the many exacting conditions imposed upon the unit.

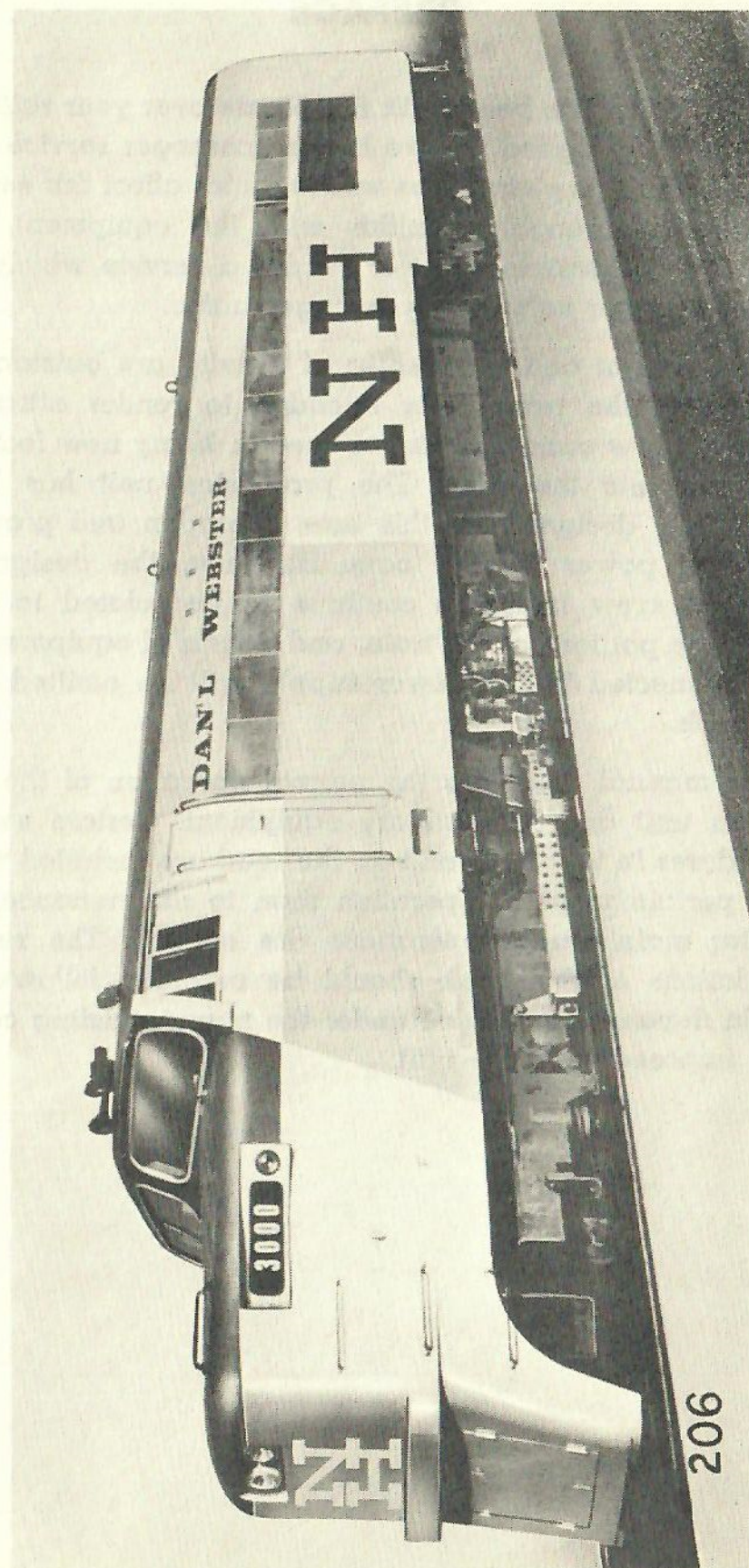


FIG. 1. VIEW OF PROPULSION UNIT

CONTENTS

	PAGE
GENERAL DATA	1
ENGINE DATA	2
GENERAL DESCRIPTION	3
DETAILS OF OPERATION	
Preliminary	29
Starting Auxiliary Engine	31
Starting Traction Engine	32
Starting and Stopping Auxiliary Motors	33
Starting and Stopping Traction Motors	33
Moving Propulsion Unit	34
Inspections During Operation	35
Indicator Lights	35
Emergency Gear Shift	36
Stopping Propulsion Unit	37
Reversing Propulsion Unit	37
Shutting Down Propulsion Unit	39
Changing Control Stations	39
Layover Procedure	42
Towing Propulsion Unit	42
Coupling Propulsion Unit to Car	43
Uncoupling Propulsion Unit from Car	44
Entering Third Rail Zone	45
Leaving Third Rail Zone	46
Operating Difficulties	47
INDEX	52, 53, 54

LIST OF ILLUSTRATIONS

FIGURE	PAGE
1. View of Propulsion Unit	Frontispiece
2. Engineer's Position	6
3. Instrument and Control Panels	7
4. Electrical Equipment Cabinet	13
5. Electrical Instrument Panel	17
6. Main Engine Overspeed Control	19
7. Cooling Water System Diagram	22
8. End View of Propulsion Unit and Car	26
9. Manual Emergency Transmission Control	38
Main Engine Exterior Views	Appendix
Auxiliary Engine Exterior Views	Appendix
Arrangement of Equipment, Propulsion Unit ..	Appendix

GENERAL DATA

1000 H.P. Baldwin-Mechydro Propulsion Unit

Weight—(Approximate) Lbs.

In Working Order	198,300
On Drivers—Front Truck (Total)	117,950
Light	190,400
Axle Load Front Truck (each)	59,150
Axle Load Rear Truck (each)	40,170

Dimensions

Overall Length (over coupling faces)	58'-9"
Width (over body)	10'-0"
Width (over handrails)	10'-6"
Height	11'-0"
Length between Center Pins	32'-7"
Overhang—Front	16'-2"
Rear	10'-0"
Wheelbase—Total	43'-7"
Truck, Propulsion	15'-0"
Truck, Rear	7'-0"
Wheel Diameter—Front Truck	36"
Rear Truck	28"

Propulsion Engine—12 Cylinder

V-Type Supercharged 1000 BHP

at 1500 RPM, Sea Level Rating

Auxiliary Engine—6 Cylinder

In-line, supercharged 465 BHP

at 1200 RPM, Sea Level Rating

Brakes, Air

Electro-Pneumatic Automatic

Minimum Curve

Supplies (Approximate)

Fuel Oil	750 Gallons
Lubricating Oil—Propulsion Engine System...	70 Gallons
Auxiliary Engine System...	71 Gallons
Transmission	24 Gallons
Axle Drive (each)	3½ Gallons
Cooling Water System.....	213 Gallons
Sand	7 Cubic Feet

ENGINE DATA

Maybach non-reversible, 4-cycle, single-acting diesel engines with combustion chamber centrally arranged.

Rotation: Counterclockwise looking at power take-off end.

	Type MD-655	Type MD-330
Cylinders	12	6
Arrangement	60° V	In-line
Cylinder Bore	7.3"	7.3"
Stroke	7.9"	7.9"
Piston Displacement	3930 cu. in.	1965 cu. in.
Rated Output*	1000 HP	465 HP
Engine Speed at Rated Output	1500 RPM	1200 RPM
Weight, less oil, water, accessories	9900 lbs.	7130 lbs.
Oil Capacity, Engine Sump	35 Gal.	44 Gal.

*At standard conditions.

GENERAL DESCRIPTION

INTRODUCTION

The diesel hydraulic propulsion unit described in this book has been specially designed to operate as an integral part of a light-weight high-speed train. It has a powerful single-engine diesel-hydraulic power plant to drive the train, and a separate single-engine diesel-electric power plant to furnish power for all auxiliary equipment on both the propulsion unit and the train. A propulsion unit is semi-permanently coupled to each end of this train, which permits operation in either direction without turning the train. Both units are controlled from one cab in the same manner as normally connected multiple unit locomotives, regardless of the presence of cars between units.

The duties and responsibilities of locomotive and train crews are not significantly changed by the use of head-end power for the cars, and no instructions on car equipment are given in this book. Both propulsion units are controlled from the cab of the leading unit where the operator and assistant are regularly stationed at control equipment which is similar to that on regular locomotives. The throttle, reverse lever, and brake pedestal control the units in conventional manner, although the instruments are adapted to indications for different internal functions of the power system. For example, automatic gear shifting in the transmission occurs instead of transition of traction motors, and certain pressure and temperature gauges are installed instead of corresponding electrical meters. General data, ratings, and other technical information about the unit appear on separate pages.

Electrical circuits are trainlined for multiple unit control, 480 volt a-c train power, d-c air brake control system and conductor's signal.

NOTE: The two units are duplicates of each other, and the descriptions which follow apply to each unit unless otherwise noted in conjunction with multiple unit operation.

ARRANGEMENT OF EQUIPMENT

The propulsion unit is mounted on two four-wheel trucks. The front truck is a self-contained power truck on which is installed the traction engine, transmission and axle drives. Two d-c traction motors are provided on this truck for driving the unit from a third rail source of power. The rear truck is a swivel type high-speed idler truck. The superstructure is divided into a nose compartment, cab, power truck compartment and auxiliary power compartment. The entire output of the main engine is available for traction. The auxiliary power plant supplies power for all lights, motors, control circuits, a-c train circuits, and supplementary equipment. The arrangement of the major pieces of equipment is shown in a drawing in the rear of the book.

The nose houses air brake system equipment, cab signal equipment, number lights, marker lights, and headlights.

The cab contains the regularly used controls for train movement. A sound deadening bulkhead separates it from the engine compartment. Doors are provided between the cab and nose, and between the cab and auxiliary power compartment. Exterior doors are provided on both sides of the cab.

The power truck compartment houses the traction diesel engine and accessories. The auxiliary power compartment contains the auxiliary diesel engine and accessories, the electrical generator, an auxiliary d-c motor to drive the generator from third rail power, the electrical equipment cabinets, the auxiliary engine control panel, and the cooling system.

Each engine is a self-contained unit incorporating its own lubricating oil system, with separate filters, strainers, pre-start pumps and protective devices. Starting systems are independent. Fuel oil and intercooler water systems are connected to both the main and auxiliary engines. The main cooling water system is connected to the main engine, auxiliary engine and to the transmission. The auxiliary engine can be operated independently of the main engine, however the main engine cannot be started or kept running unless auxiliary power is supplied. Normally the auxiliary

power plant on each unit supplies power for the main engine and locomotive auxiliaries on that unit. In an emergency when operating in multiple, one auxiliary power plant can supply power for both main engines and locomotive auxiliaries.

CAB

The cab is arranged for right hand drive. The control stand, brake valves and gauges, and accessories, such as speedometer, transmission temperature indicator, defroster, wiper valve, bell valve, sander valve, horn valve and heater are conveniently mounted at the engineer's position, Fig. 2. A transmission hot oil light, transmission temperature indicator and shut down contactor, engine tachometer, main engine lube pressure, and water temperature gauges, are mounted on the bulkhead between the cab and power compartment, Fig. 3a. Auxiliary engine instruments and controls are at the fireman's station, Fig. 3b.

CONTROL STAND

A control switch is the master on-off switch for the control circuits. It must be closed on the leading unit before any power can be obtained from the battery to start the engines, to keep them running, or to operate auxiliary or traction motors.

The throttle lever controls the speed and power of the propulsion unit in the conventional manner. It has 8 positions, STOP, IDLE, and 6 running positions. The STOP position should be used only to stop the traction engine for layover periods. A button on the handle must be pressed to get into STOP position.

The reverse lever controls the direction of travel through relays which operate magnets in the transmission shifting mechanism. It is mechanically interlocked with the throttle so that it cannot be moved except when the throttle is in IDLE position. The standard FORWARD, OFF and REVERSE settings result in corresponding settings of the transmission.

Circuit breakers for air brake circuits and certain lighting circuits are located on the control stand. Other breakers are listed in the paragraph on Electrical Equipment Cabinets.

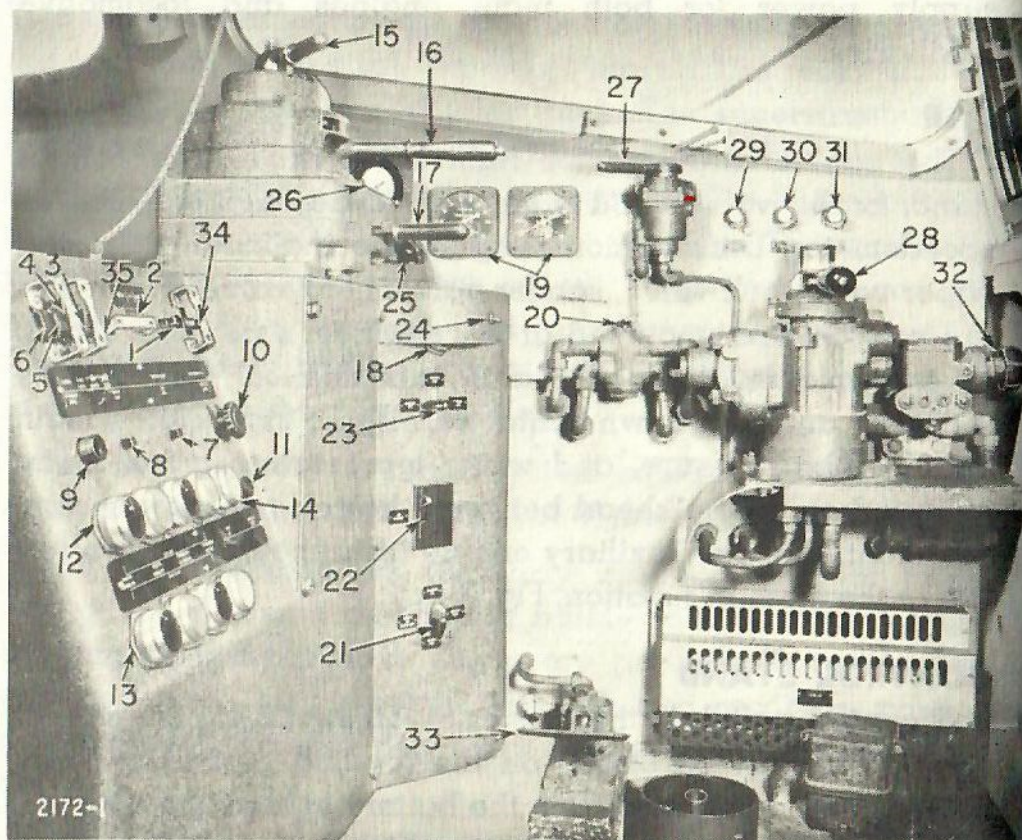
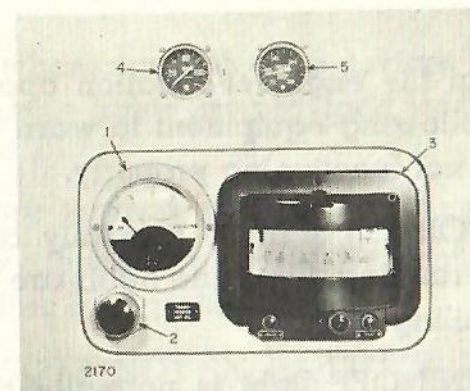


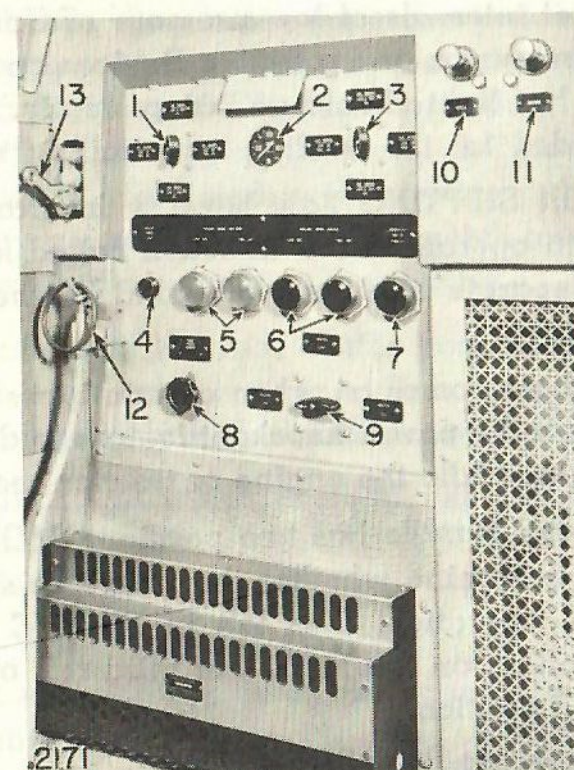
FIG. 2. ENGINEER'S POSITION

- | | |
|--------------------------------------|--|
| 1. HEADLIGHT AND NUMBER-LIGHT SWITCH | 17. REVERSE LEVER |
| 2. THIRD RAIL SHOE SWITCH | 18. TRAIN ORDER LIGHT |
| 3. GAUGE LIGHTS SWITCH | 19. DUPLEX PRESSURE GAUGES, AIR BRAKE SYSTEM |
| 4. MARKER LIGHT SWITCH | 20. DOUBLE HEADING COCK |
| 5. CLASS LIGHTS SWITCH | 21. HEATER AND DEFROSTER SWITCH |
| 6. CONTROL SWITCH | 22. AIR BRAKE CIRCUIT BREAKER |
| 7. CAR LIGHTS SWITCH | 23. CAB HEATER SWITCH |
| 8. BACK UP LIGHT SWITCH | 24. TRAIN ORDER LIGHT SWITCH |
| 9. ATTENDANT BUTTON | 25. SPEED INDICATOR |
| 10. NAME PLATE LIGHT RHEOSTAT | 26. TRANSMISSION TEMPERATURE INDICATOR |
| 11. TRACTION ENGINE START BUTTON | 27. PARKING BRAKE VALVE |
| 12. LEADING UNIT INDICATOR LIGHTS | 28. "LWL" BRAKE VALVE |
| TRACTION MOTOR ON | 29. WIPER VALVE (ROTATE TO ADJUST SPEED) |
| TRACTION ENGINE OFF | 30. BELL VALVE |
| TRANSMISSION OIL PRESSURE | 31. SANDER VALVE |
| TRANSMISSION SHIFTING | 32. FEED VALVE |
| 13. TRAILING UNIT INDICATOR LIGHTS | 33. SAFETY CONTROL PEDAL |
| 14. POWER OFF LIGHT | 34. PANTOGRAPH SWITCH |
| 15. POWER SELECTOR HANDLE | 35. EMERGENCY SHOE DOWN SWITCH |
| 16. THROTTLE | |



(a) Cab Bulkhead.

- | | |
|--|----------------------------|
| 1. ENGINE TACHOMETER | 4. LUBE OIL PRESSURE GAUGE |
| 2. TRANSMISSION HOT OIL LIGHT | 5. WATER TEMPERATURE GAUGE |
| 3. TRANSMISSION TEMPERATURE INDICATOR AND SHUTDOWN CONTACTOR | |



(b) Fireman's Station.

- | | |
|---|---|
| 1. AUXILIARY ENGINE CONTROL SWITCH (AECS) | 6. AUXILIARY MOTOR RUNNING INDICATOR LIGHTS |
| 2. AUXILIARY ENGINE LUBE OIL PRESSURE GAUGE | 7. GENERATORS NOT IN PARALLEL INDICATOR LIGHT |
| 3. AUXILIARY MOTOR CONTROL SWITCH (AMCS) | 8. RHEOSTAT—NAMEPLATE DIMMING |
| 4. AUXILIARY ENGINE START BUTTON (AESB) | 9. FIREMAN'S HEATER SWITCH |
| 5. AUXILIARY ENGINE SHUTDOWN INDICATOR LIGHTS | 10. BELL VALVE |
| | 11. WIPER VALVE (ROTATE TO ADJUST SPEED) |
| | 12. FUEL SHUTOFF RING |
| | 13. CONDUCTOR'S EMERGENCY VALVE |

FIG. 3. INSTRUMENT AND CONTROL PANELS

Indicator lights at the engineer's station operate in conjunction with the following equipment to warn the operator if the equipment is not functioning properly.

TRACTION MOTOR ON light is normally on when the traction motors are running. Separate lights are provided for the leading and trailing units.

TRACTION ENGINE OFF light is normally off when the engine is running. It comes on during engine starting, or when any protective devices have shut the engine down. Separate lights are provided for the leading and trailing units.

TRANSMISSION OIL light is on when transmission oil pressure is low. Brief intervals of low pressure are normal, as described in paragraphs on Protective Devices and Moving Populsion Unit, but light should go out promptly. Separate lights are provided for the leading and trailing units.

TRANSMISSION SHIFTING light is on if the transmission has not shifted to operate in the direction called for by the reverse lever. Separate lights are provided for the leading and trailing units.

POWER OFF light comes on when certain types of brake applications cause the power knockout feature to disengage the transmission and idle the engine or traction motors.

A **Power Selector Handle** has two positions, **MOTOR** and **ENGINE**, which determine whether the units are set up for motor or engine operation. It is left in **ENGINE** position, except when running on third rail. For third rail operation, it is set in **MOTOR** position.

Third Rail Switch, see Page 27.

FIREMAN'S STATION

Auxiliary engine and auxiliary motor controls are mounted at the fireman's station, Fig. 3(b). The control switches have four positions; **LEAD AND TRAIL ON**, **LEAD AND TRAIL OFF**, **LEAD ON TRAIL OFF**, and **LEAD OFF TRAIL ON**.

AUXILIARY ENGINE SHUTDOWN light is normally off when the engine is running. It comes on during engine

starting or when any protective devices have shut the engine down. Separate lights are provided for the leading and trailing units.

AUXILIARY MOTOR RUNNING light is normally on when the auxiliary motor is running. Separate lights are provided for the leading and trailing units.

GENERATORS NOT IN PARALLEL light is normally off when auxiliary engines or auxiliary motors are operating in parallel. It comes on if one auxiliary engine or motor stops, or if either main breaker opens.

TRACTION ENGINE

A 1000 H.P., 12 cylinder, supercharged, four-cycle, V-type, diesel engine is mounted on the power truck. Its speed ranges from 600 to 1500 rpm., depending on the setting of the throttle. Full engine power is delivered to a transmission which is connected to the driving axles. The engine is started by a small starting motor which receives power from the battery when cranking the engine.

Illustrations in the rear of this book identify the principal external items on the engine. Operators and hostlers need be concerned only with the following items:

OIL FILTER CLEANING LEVERS should be turned periodically, twice daily or at the end of each trip. (Item 36, plates M0610, M0611.)

TURBOCHARGER OIL SIGHT GAUGE should show a minimum flow of 8 drops of oil per minute at idle speed, 16 at full engine speed. (Item 13, plate M0608.) Report to maintenance if the drip oiler (item 22, plate M0606) needs adjustment.

OIL LEVEL GAUGE (dipstick) should be examined periodically to check the lube oil level. Two balls are welded on the stick to mark the upper and lower limits of oil level.

VENT SCREW is used to bleed air from the fuel line. Crack open until air bubbles disappear in the plastic hose beside the vent screw. (Items 32 and 34, plate M0605.)

STOP SOLENOID in governor can be used for emergency stopping of the engine. Refer to page 39.

OVERSPEED TRIP is a conventional protective device. Refer to page 18.

TRANSMISSION

The transmission is a fully automatic mechanism consisting of a disengaging torque converter and three pairs of helical gears in constant mesh. The disengaging torque converter consists of an impeller which is driven by the engine and a turbine with two sets of blading which shifts along its axis to engage or disengage the output shaft. Shifting is completely automatic, accomplished by the engaging or disengaging of positive over-running claw clutches. It is selected by the control mechanism and varies in conjunction with engine and train speed. A reverse gear is installed in the transmission controlled by the reverse lever. Oil in the casing is circulated through the transmission and converter by self-contained lubricating oil pumps. Two balls on the OIL LEVEL GAUGE show the upper and lower limits of oil level.

AXLE DRIVE

An axle drive is mounted on each axle of the power truck. Drive shafts with universal joints connect the transmission to each axle. Power is delivered to the axle through a pinion gear meshed with an axle mounted gear contained in an axle drive housing. The torque reaction of the axle drive is absorbed by a torque reaction member supported on the truck frame. The axle drive is supported on the axle by roller bearings. The gears and bearings within the axle drive housing are lubricated by an internal axle-driven oil pump. Oil level must be maintained within limits indicated on an OIL LEVEL GAUGE at the oil filler inlet.

AUXILIARY ENGINE

A 465 H.P., 6 cylinder, supercharged, four cycle, in-line diesel engine, installed in the auxiliary power compartment, drives the air compressor, and furnishes electrical power for the principal propulsion unit auxiliaries and all

train service equipment through an a-c generator. It is governed for a constant speed of 1200 rpm., so that proper frequency is maintained by the a-c generator.

Fuel pressure for both engines, water temperature and lube oil pressure for the auxiliary engine are shown on gauges mounted on the cabinet at the rear of the engine.

Illustrations in the rear of this book identify the principal external items on the engine. Operators and hostlers need be concerned only with the following items whose function has been described in the paragraphs for the main engine:

OIL FILTER CLEANING LEVER, item 34, plate M0307 and M0309.

TURBOCHARGER OIL SIGHT GAUGE, 6 to 10 drops per minute, item 1, plate M0301.

OIL LEVEL GAUGE, item 16, plate M0301.

VENT SCREW AND PLASTIC HOSE, items 39, 42, plate M0308.

STOP SOLENOID, item 5, plate M0301.

STOP LEVER ON GOVERNOR, refer to page 39, item 6, plate M0301.

GENERATOR

A 480 volt, 3 phase, 60 cycle, a-c generator having a capacity of 250 KW (at 80% power factor) is normally driven by the auxiliary engine. During third rail operation it is driven by the auxiliary motor which is regulated for proper speed. It provides power for train service (heating, lighting, and air conditioning), and for the radiator fans, intercooler fan, water pumps, main engine pre-start lube oil pump, battery charging, cab heaters, and immersion heaters on the propulsion unit. Each circuit to the pumps and fan motors is protected by a circuit breaker in the electrical equipment cabinet. These breakers are normally left closed, and must be reset manually if they trip open.

BATTERY

The storage battery supplies power for all d-c control circuits, starting motors, auxiliary engine pre-start lube oil pump motors, fuel pump motor, air brake magnet valves, cab signal circuits, and lighting circuits on the propulsion unit. It is charged by the a-c generator through suitable transformers and rectifiers. A total of 32 cells, providing a nominal 64 volt circuit, are mounted in boxes built integral with the fuel tank between the trucks under the frame. A battery contactor (VRBC) automatically disconnects the battery from the charging circuit if there is no voltage on the a-c side of the rectifiers. The rectifiers maintain a constant d-c output regardless of variations in load on the d-c circuit. A battery charging control breaker (BCCB) in the electrical equipment cabinet is connected in the a-c line to the transformers, and is normally left closed.

NOTE: A special quick acting fuse in the electrical equipment cabinet is installed in the d-c side of the rectifiers. This fuse is specially wired in place, as clips do not give satisfactory contact.

A standby receptacle is provided at extreme rear corner on each side, for connection to 220 volt, 3 phase, 60 cycle a-c power from wayside or terminal circuits. A wayside control breaker (WCB) in cabinet (83), normally open, must be closed to complete the circuit. Only the battery charging equipment, and the intercooler pump motor, are connected to the standby receptacle. Interlocks prevent the wayside circuit from supplying power when the a-c generator is in operation.

ELECTRICAL EQUIPMENT CABINETS

CAUTION: High voltage, third rail or 3-phase train power, may exist in the cabinets at all times, whether in or out of electrified territory. Adequate safety rules should be observed.

Electrical equipment cabinets are located on the left side of the engine compartment, (items 80-83, Arrangement of Equipment Drawing), and in the rear of the engine compartment (item 84). Manually operated equipment is normally

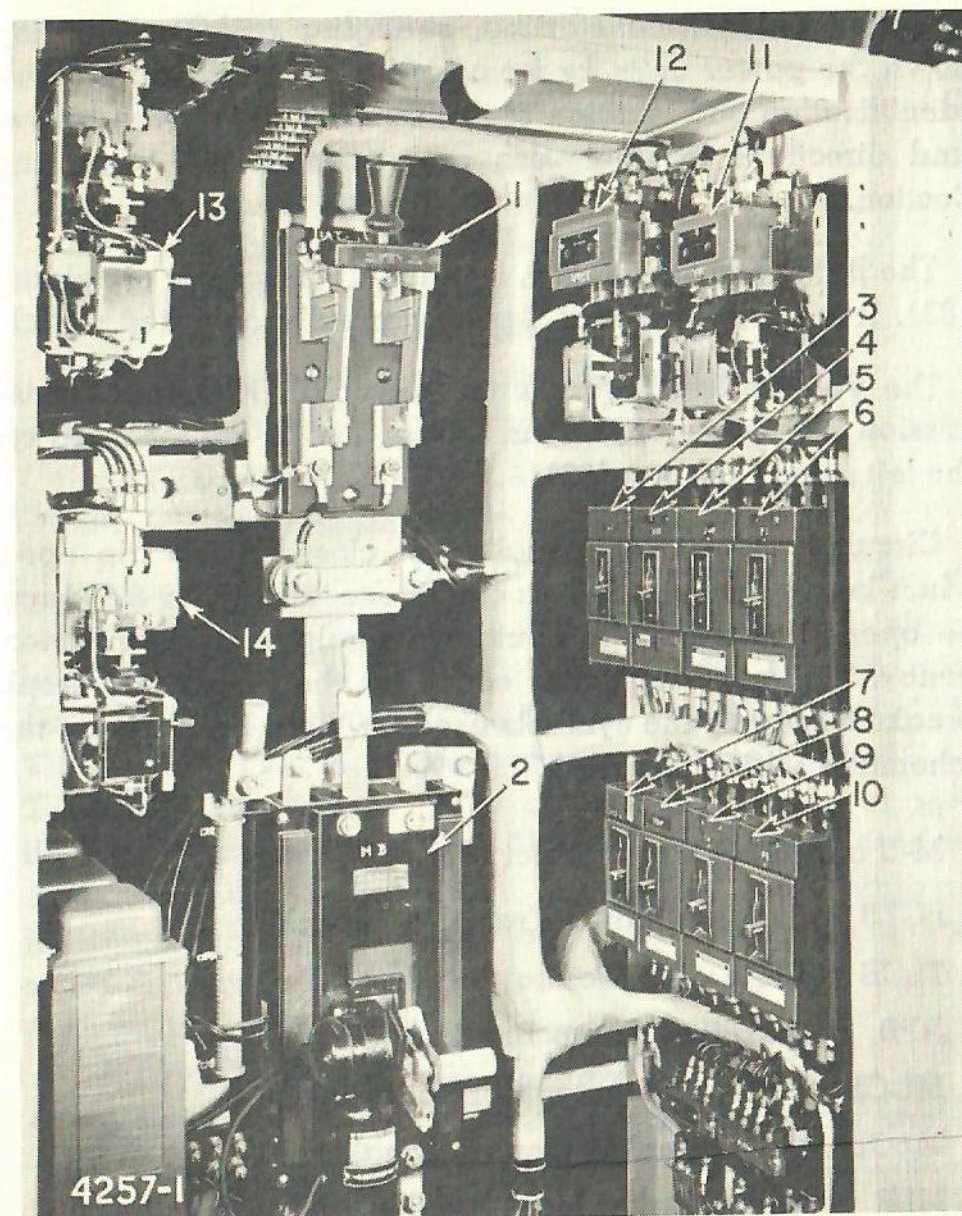


FIG. 4. ELECTRICAL EQUIPMENT CABINET
Battery, Pump and Fan Control Portion.

- | | |
|--|---|
| 1. BATTERY SWITCH | 8. TRACTION ENGINE LUBE PUMP BREAKER (TELP) |
| 2. MAIN TRAINLINE BREAKER (MB) | 9. INTERCOOLER FAN BREAKER (IF) |
| 3. INTERCOOLER WATER PUMP BREAKER (IWP) | 10. No. 1 FAN BREAKER (F1) |
| 4. BATTERY CHARGING CONTROL BREAKER (BCCB) | 11. INTERCOOLER FAN CONTACTOR (IF) |
| 5. JACKET WATER PUMP BREAKER (JWP) | 12. BATTERY CHARGING CONTACTOR (VRBC) |
| 6. No. 2 FAN BREAKER (F2) | 13. No. 1 FAN CONTACTOR (FS1, F1) |
| 7. WAYSIDE CONTROL BREAKER (WCB) | 14. No. 2 FAN CONTACTOR (FS2, F2) |

operated only when starting, changing ends, or shutting down the power units, or for certain emergency operations. Identification and location of this equipment is given below, and directions for their use are given in the Operating Section.

The **Battery Switch**, Fig. 4, is in the upper center of cabinet (83). It is a conventional 2-pole manually operated switch.

The **Voltage Regulator Cut-out Switch RGCO**, and **Transmission Thermometer Cut-out Switch TTCO**, are mounted on the left side of cabinet (82).

Circuit Breakers are usually left closed. They trip open when heavy current loads a circuit excessively, or they may be opened manually to shutdown equipment in an emergency. The following letter codes for the respective circuit breakers refer to the symbols used for these breakers on the schematic wiring diagram.

M-U and Third Rail Cabinet (81).

BCTB	Battery Charge Train Line Breaker
TLCB	Train Line Control Breaker
APB	Auxiliary Pump Breaker
MCCB	Motor Contactor Control Breaker
MBCB	Main Breaker Control Breaker
MLR	Front Marker Light Breaker

The **Multiple Unit Switch** in cabinet (81) is set in **LEADING** position on the lead or control unit, and in **TRAILING** position on the trailing or controlled unit.

Train Power and Locomotive Control Cabinet (82).

ACCB	Alternating Current Control Breaker
CHB	Cab Heater Breaker
LTG	Lighting Breaker
HDLT	Headlight Breaker

Battery, Pump, and Fan Control Cabinet (83).

MB	Main Trainline Breaker
F1	No. 1 Radiator Fan Breaker
F2	No. 2 Radiator Fan Breaker
IF	Intercooler Fan Breaker
IWP	Intercooler Water Pump Breaker
JWP	Jacket Water Pump Breaker
BCCB	Battery Charging Control Breaker
TELP	Traction Engine Lube Pump Breaker
WCB	Wayside Control Breaker

Speed Regulator Cabinet (84).

SRB	Speed Regulator Breaker
-----	-------------------------

The traction engine control switch (TECS), and traction motor control switch (TMCS) cabinet (81) have four positions: **LEADING ON—TRAILING ON**, **LEADING ON—TRAILING OFF**, **LEADING OFF—TRAILING ON**, and **LEADING OFF—TRAILING OFF**. They are normally left in **LEADING-ON, TRAILING-ON** position. They cut out the engine or motor if the need arises. Contactors AMB, TMLB, and AAC4 cabinet (80) trip like breakers but cannot be reset manually. Indicator lights on Electrical Instrument Panel, Fig. 5, show when AMB or TMLB have tripped. Contactors are reset by a push button below the light.

CAUTION: Do not operate any equipment in the cabinets by hand unless specific directions are given in the operating and servicing instructions.

FAN STARTING CONTACTORS

A starting contactor in each fan motor circuit has built-in thermal overload relays. They give protection against unbalanced phase load, open line, or similar 3-phase faults which would not necessarily trip the fan breakers. Four red tipped reset levers are on the front of each contactor. If any relay trips, the corresponding reset lever will be out of place and must be pressed in to reset the contactor. The circuit breaker on the right side of the cabinet should first be opened. With the breaker open, the contactor can be reset, and when the breaker is closed, the contactor is free to trip in the event of further trouble.

ELECTRICAL INSTRUMENT PANEL

Instruments on the electrical equipment cabinet Fig. 5 include a battery ammeter, a generator voltmeter, a frequency meter, traction motor overload light and reset button, auxiliary motor overload light and reset button, and main breaker selector switch. A trouble light receptacle is also installed on this panel. Normal instrument readings are given in the Operating Section.

LIGHTING CIRCUITS

The cab lights, auxiliary compartment equipment lights, cabinet lights, nose light and trouble light receptacles are fed through a 35-ampere lighting breaker in equipment cabinet (82). The breaker is directly connected to the battery, and these lights can be lit regardless of the position of the battery switch. A switch for the back-up light is mounted beside the door at the rear vestibule and on the control stand. Switches for the auxiliary compartment are located beside the rear door and in the aisle adjacent to the cab.

The headlight and number lights are controlled by a 3-position dimming switch at the control stand and is fed through a separate 35-ampere breaker in equipment cabinet (82).

Gauge lights and rear marker lights are fed through 15-ampere breakers identified by nameplates at the control stand. The battery switch must be closed before these lights will operate. Front marker lights are controlled from a switch located outside the locomotive on the number light box. Breaker is located in cabinet (81).

NOTE: Headlight, front and rear, number lights, and marker lights are not trainlined and therefore affect only the unit on which the switch is installed. When train is coupled, rear marker light, number light and headlight must be turned on from rear locomotive.

PROTECTIVE DEVICES

Any of the following difficulties will shut down either engine. Loss of the auxiliary engine will automatically shut down the main engine. If both engines shut down, operators should check the auxiliary engine first.

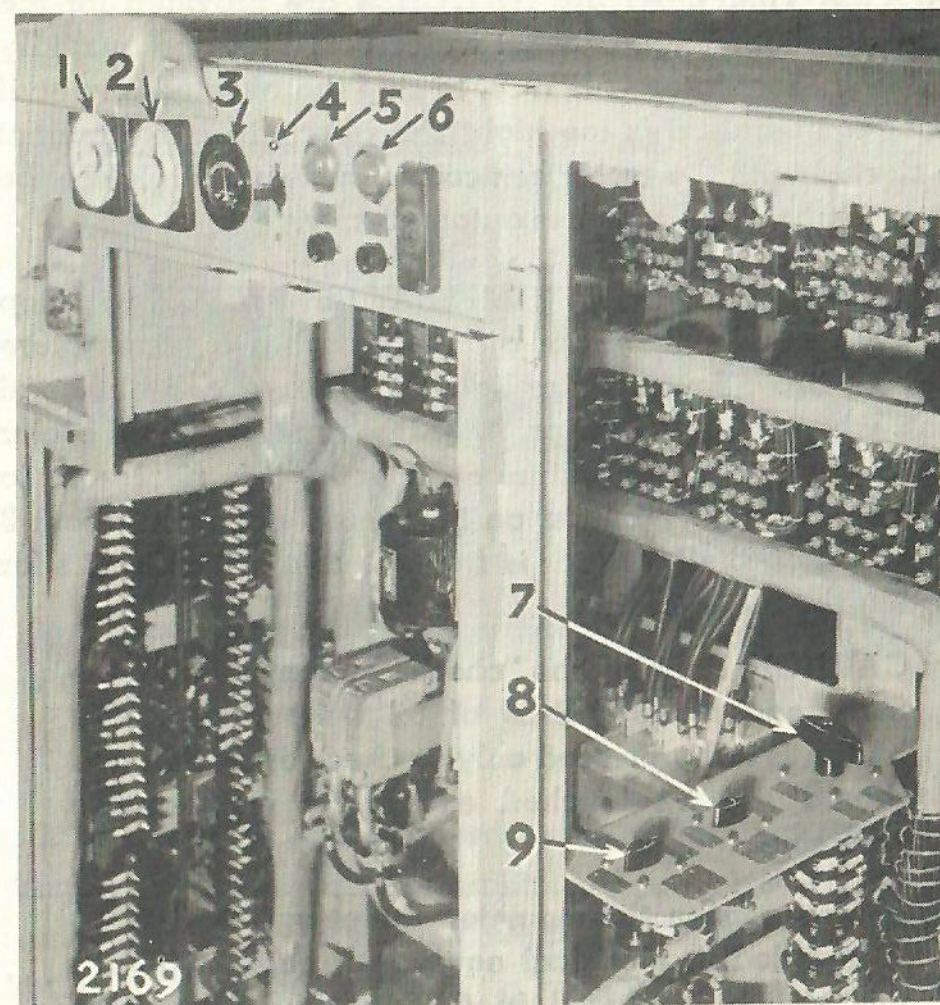


FIG. 5. ELECTRICAL INSTRUMENT PANEL

- | | |
|--|---|
| 1. VOLTMETER | 6. AUXILIARY MOTOR OVERLOAD LIGHT AND RESET |
| 2. FREQUENCY METER | 7. MULTIPLE UNIT SWITCH |
| 3. BATTERY AMMETER | 8. TRACTION ENGINE CONTROL SWITCH |
| 4. MAIN BREAKER CONTROL SWITCH | 9. TRACTION MOTOR CONTROL SWITCH |
| 5. TRACTION MOTOR OVERLOAD LIGHT AND RESET | |

LUBE OIL PRESSURE SWITCHES are provided on both the traction engine (TELS1, TELS2) and auxiliary engine (AELS) to stop the affected engine if oil pressure is too low.

WATER TEMPERATURE SWITCHES are provided for the main (traction) engine jacket water (TEJWT), and auxiliary engine jacket water (AEJWT), to stop the affected engine if water temperature is too high. The affected engine cannot be started until the water has cooled sufficiently to close the water temperature switches automatically.

A **TRANSMISSION OIL TEMPERATURE SWITCH** will stop the main engine if transmission oil reaches a temperature of about 375°. An indicator light on the rear cab bulkhead lights when this switch trips. After the transmission oil cooler has lowered the temperature sufficiently, it is necessary to push a reset (free) button on the meter, and hold about 3 seconds until the indicator is free, to restore the circuits for starting the main engine.

CAUTION: Pressing the "check" button will stop the main engine regardless of oil temperature. This button is to be pressed only to check operation and should not be touched except by maintenance personnel.

A transmission thermometer cutout switch (TTCO) is installed in electrical equipment cabinet (82). If this switch is placed in OFF position, the main engine will stop and cannot be started. This switch is for maintenance purposes only and should not be opened by operating crews.

ENGINE OVERSPEED CONTROLS are provided to stop either diesel engine if its speed becomes excessive.

The main engine device is shown in Fig. 6. It is reset by pushing the black button in the far end of the casing. A chrome button on the side of the casing is for test purposes. To release the chrome button after pressing it, turn the knurled knob encircling the button. The device trips at half engine speed when the chrome button is pressed in.

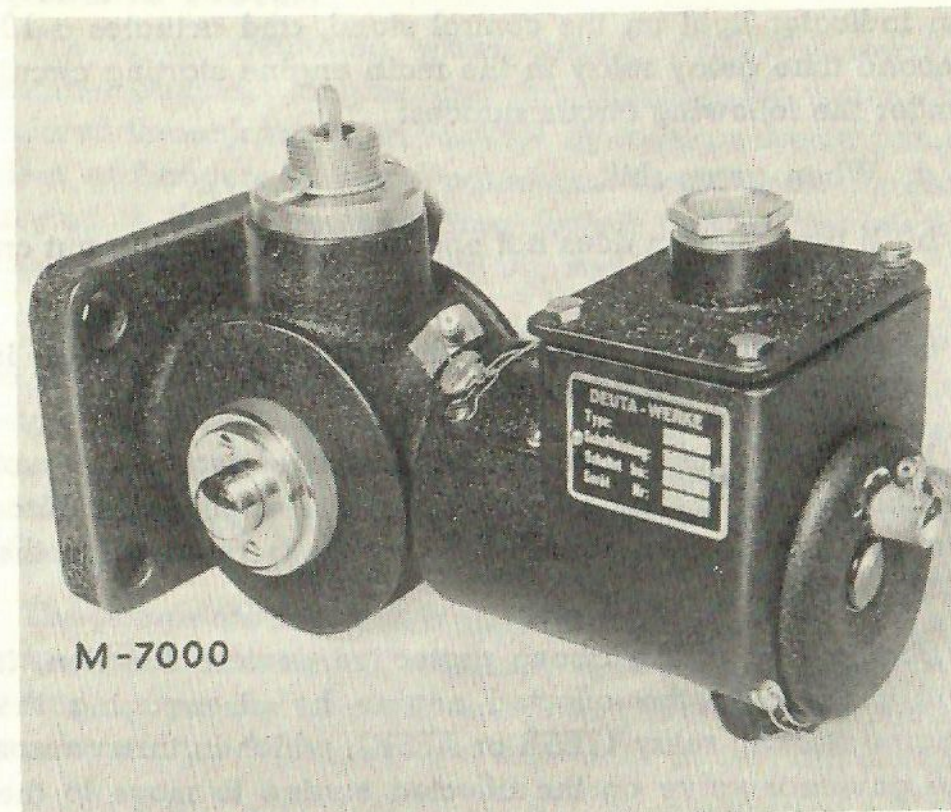


FIG. 6. MAIN ENGINE OVERSPEED CONTROL

The auxiliary engine overspeed control consists of a damper in the air intake manifold tripped by oil pressure released by an overspeed governor. (Items 7 and 9, plate M0306.) When oil pressure is released under overspeed conditions, the damper is tripped, shutting off the air supply, the speed regulating governor is moved to the shutdown position and the engine stops. To reset, turn the damper lever till an engaging latch holds it in open position. In the event the damper continues to trip without apparent cause break the seal and turn the stop cock in the oil line to the damper to the off position.

CAUTION: Auxiliary engine speed should be carefully watched by observing the frequency meter when operating with this valve closed.

A TRANSMISSION OIL PRESSURE SWITCH (TOPS) lights an indicator light on the control stand, and actuates a 10-second time delay relay in the main engine starting circuit under the following circumstances:

- a. When gears shift.
- b. If transmission does not engage when notching out on the throttle.
- c. If transmission does not disengage when throttle is returned to IDLE position.

If the light does not go out within the 10 second interval established by the time delay relay, the engine will automatically shut down unless the throttle is returned to the IDLE position.

Should any of the above protective devices function, it will shut down the affected engine by disengaging the engine starting relay (TESR or AESR), which in turn causes the governor valve on the affected engine to move to the shutdown position. The engine starting relays are mounted in equipment cabinet (82), and must be energized in order to start the engine or keep it running.

A TRANSMISSION SHIFTING LIGHT on the control stand is lit by a transmission interlock if the transmission has not shifted to operate in the direction called for by the reverse lever. Gears may be set manually in an emergency as directed on page 36.

A FUEL SHUT-OFF VALVE in the fuel line, located on top of the fuel tank, is operated by pull-rings for quickly shutting off the flow of the fuel oil in case of fire, collision, or other emergency. Three (3) rings are provided, one in the cab, and one on each side of the propulsion unit beneath the frame adjacent to the fuel tank fill. To open the fuel line after tripping this valve, manually reset the valve. The valve may be reached through a floor plate in the left aisle near the auxiliary power unit. It may be necessary to bleed air from the fuel line by opening the engine vent screws pointed out in the engine paragraphs, page 9 and 11.

COOLING SYSTEM

The main circulating water system cools the traction engine, auxiliary engine and transmission by water circulated through the main radiator by a motor driven pump. Heat exchangers on each engine and transmission are connected to the main circulating system to cool the engine lubricating and piston cooling oil, and transmission oil.

A separate intercooler circulating water system is installed to cool the air leaving the turbocharger and entering the engine. Water is circulated by a separate motor driven pump which circulates water from the turbocharger intercoolers through a small radiator above the traction engine. (See Fig. 7.)

The pumps are installed in the radiator compartment. They operate continuously at constant speed, and require no attention from the operator except to check that the circuit breakers in the 3-phase power line to the motors are closed.

To fill the system, add water through filler lines located under the left side of the frame at the rear of the front truck, being careful to avoid trapping air in the system. Make up water may be added through filler lines (Item 61 Arrangement Drawing) at the rear of the unit. Avoid adding cold water to a hot engine, or if it is urgently necessary, add it very slowly. An expansion tank vented to the atmosphere acts as a reservoir for maintaining a full system. The water level must be kept above the top of the gauge at the front of the expansion tank in auxiliary compartment.

To drain the system completely to avoid freezing, open all drains shown on the water system diagram, and empty low points in the main and intercooler pumps.

Standby heating and circulation of the cooling water system is provided through a standby steam connection located at the right rear of the locomotive (Item 61B Arrangement Drawing) and the standby receptacle for operation of the intercooler pump motor and battery charging. Under such circumstances, the intercooler pump circulates water through all portions of the cooling system. Check valves are installed

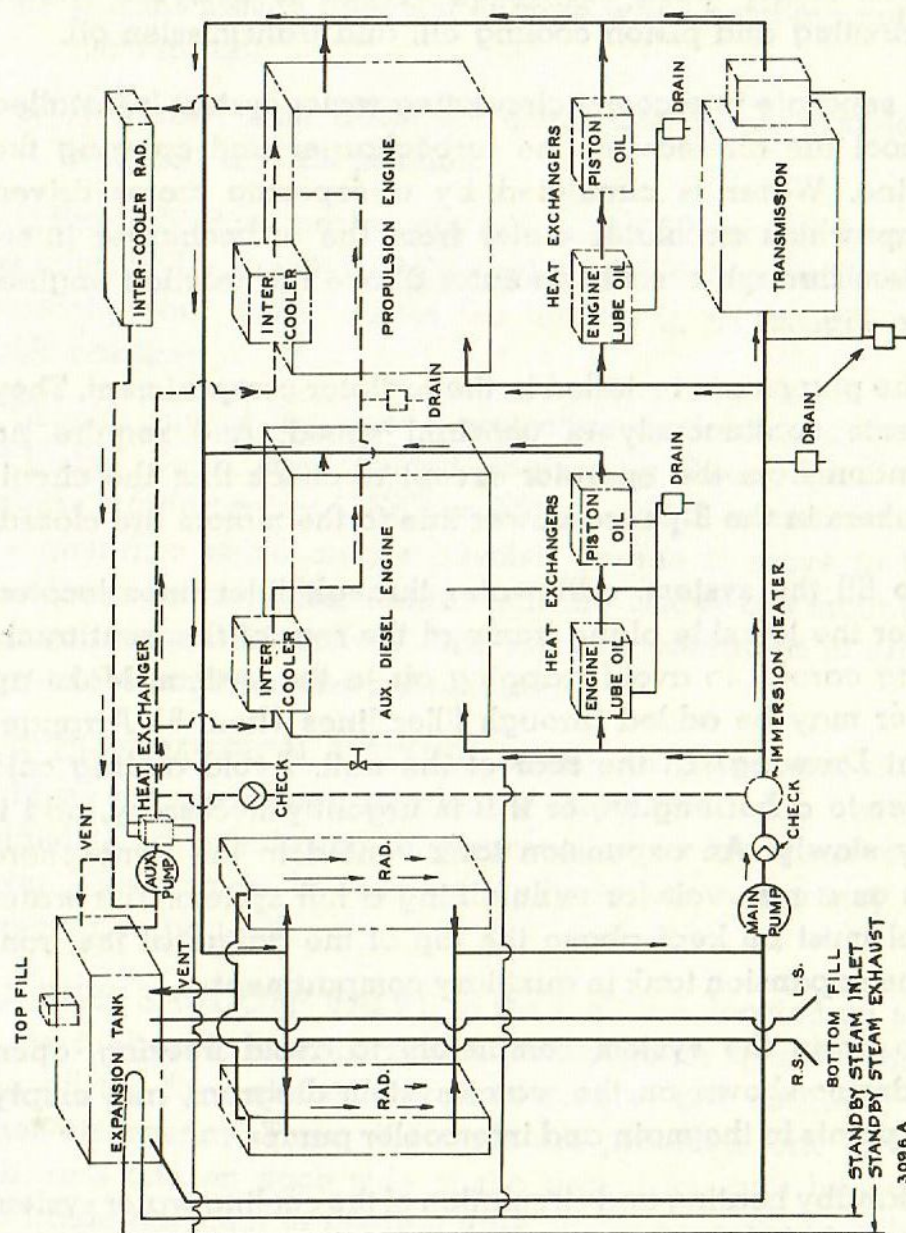


Fig. 7. COOLING WATER SYSTEM DIAGRAM

in the water system to permit complete circulation without setting any valves manually.

CAUTION: Water level in the expansion tank must be kept full to cover the steam heating coil. After connecting to wayside power, check to see that intercooler water pump is rotating in the right direction. If not, change leads in jumper cable or terminal circuit.

Standby electric immersion heating is provided when the A.C. generator is in operation. See page 42, Layover Procedure.

RADIATORS AND SHUTTERS

Radiators and adjustable shutters are vertically mounted on each sidewall of the propulsion unit at the rear of the auxiliary power compartment. A separate radiator and motor driven fan for the intercooler water system is mounted in the propulsion engine compartment.

Shutters are air-operated and thermostatically controlled by temperature switches. A 2-position 3-way cock on the radiator front bulkhead, beside the magnet valve, can be set manually to open the shutters if the automatic control of the air line fails.

Fans in the radiator section draw air in through the sides, and force it out through the roof. Each fan in the main radiator section is driven by a 40 H.P. motor connected to the 3-phase power line. The fan above the traction engine is driven by a 15 H.P. 3-phase motor. If one main fan motor must be cut out, the other fan motor will operate automatically. However, watch engine water temperature to prevent overheating and shutdown.

AIR COMPRESSOR

The air compressor is belt driven from the end of the auxiliary motor at a constant speed of 1000 rpm., displacing 112 cubic feet per minute. A pneumatically operated compressor governor operates to load the compressor when the

main air reservoir drops to 130 lbs., and unloads when the pressure builds up to 140 lbs. In third rail operation the auxiliary motor drives the air compressor.

AIR BRAKES (SCHEDULE "LWE")

A self-lapping LWL type brake valve is provided for control of an electro-pneumatic straight air brake system, and an auxiliary automatic emergency brake system.

This brake valve has three handle position:

- (a) **RELEASE**, at the extreme left.
- (b) **STRAIGHT AIR APPLICATION** which extends through the arc from release position to the internal quadrant notch. This notch is the **FULL SELF LAPPING** position.
- (c) **FULL AUTOMATIC APPLICATION (Emergency)** at the extreme right.

A parking brake valve of the self lapping type is provided to control the propulsion unit brakes only. It is intended to be used only for applying the propulsion unit brakes when it is parked.

The electro-pneumatic system consists of magnet valves on the propulsion unit and on each car which apply or release the brakes by controlling the straight air pipe system. The magnet valves are controlled through trainline electrical circuits from the master relay and circuit breaker on the propulsion unit. The contacts of the master relay and circuit breaker are actuated by control pipe pressure as regulated by movement of the LWL brake valve handle. Simultaneous electro-pneumatic and straight pneumatic build-up of the straight air pipe is provided from the propulsion unit also controlled by the LWL brake valve handle. Straight pneumatic control of the straight air pipe system is therefore always available should it be necessary to open the air brake circuit breakers due to electrical malfunction of the electro-pneumatic system. A second pipe throughout the train, called the Supervisory Line, gives automatic break-in-two protection, charges the train brake and air spring system, and propagates safety control type and conductor's valve

type brake applications. It can be controlled from the LWL brake valve to provide a full Automatic Brake application in case of an emergency. All Automatic (Emergency) type brake applications actuate the Power Knockout feature which disengages the transmission and idles the engine.

This brake system cannot be operated with cars equipped with conventional type automatic brake equipment. However, a towing brake arrangement is included in the propulsion unit brake equipment for controlling the straight air brake system on the train through any conventional type automatic brake equipment on the towing locomotive.

A conductor's emergency valve at the fireman's station, and a safety control feature operated by foot pedal, are included in the brake equipment. Both result in an Automatic (Emergency) type brake application when actuated.

To reset after any Automatic (Emergency) application, move the throttle to IDLE position, reclose conductor's valve (if actuated by this valve), depress foot pedal (if actuated by safety control), move the "LWL" brake valve handle to FULL SELF LAPPING position and keep it there until Supervisory Line pressure reaches approximately 90 psi, then brake valve handle can be moved to running position to release brakes.

Manufacturers of brake equipment can furnish detailed operating instructions.

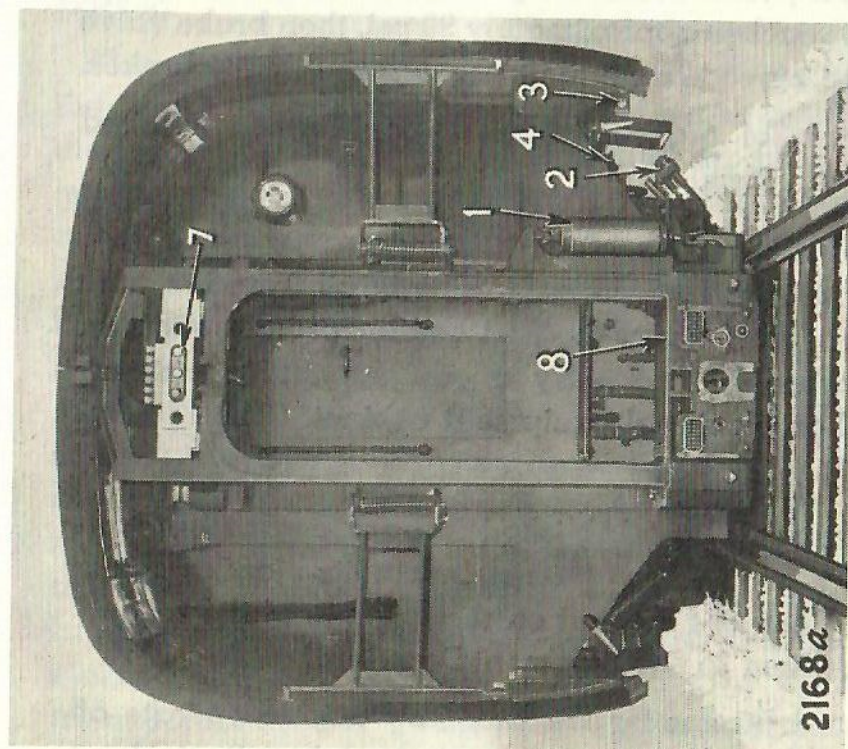
FUEL OIL PUMP

One motor driven fuel oil pump draws oil from the tank and maintains pressure at the fuel header of both engines. Fuel oil pressure is shown by a gauge on the auxiliary engine panel on electrical equipment cabinet. (84.)

LUBE OIL PUMPS

Oil pressure must be established in each engine lubricating system by its pre-start pumps before its starting motor will operate. They are located on the left side of the respective engines. (Item 35 Arrangement Drawing.)

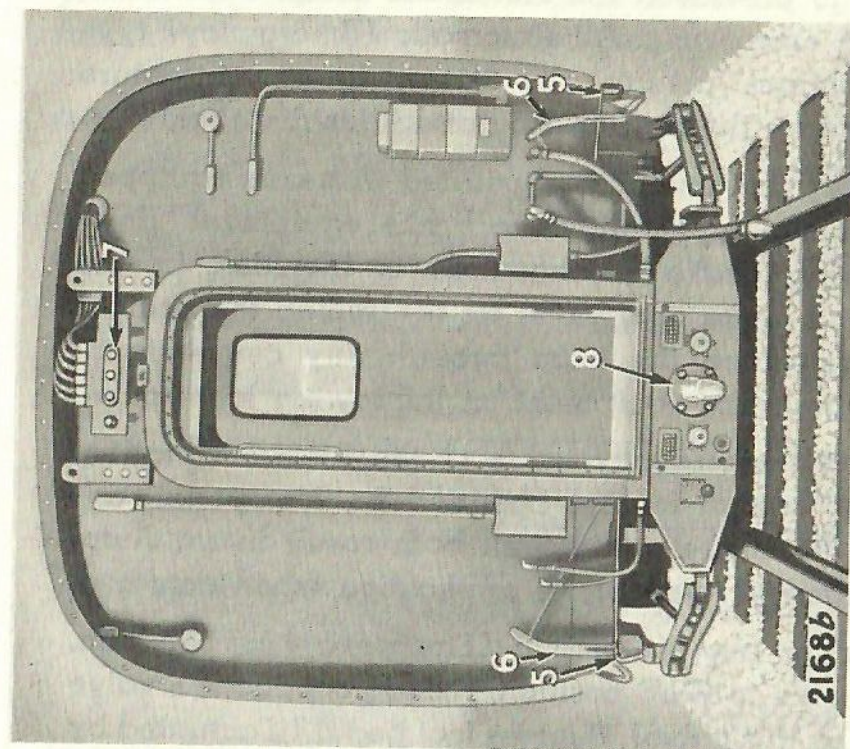
Two pre-start pumps for the auxiliary engine operate off the battery. One pump circulates engine lube oil at about 40# pressure. The other supplies oil to the governor at about



1. DOUBLE ACTING COUPLING CYLINDER
2. B-4 UNCOUPLING VALVE
3. UNCOUPLING INDICATOR LIGHT

Fig. 8. END VIEW OF PROPULSION UNIT AND CAR

4. SUPERVISORY LINE CUT-OUT COCKS—PROPULSION UNIT
5. SUPERVISORY LINE CUT-OUT COCKS—CAR. (Pull Out to Close.)
6. DEFATION VALVE HANDLE. (Pull Out to Close.)
7. THREE PHASE A-C TRAIN POWER CIRCUIT
8. COUPLER



180# pressure. Governor oil pressure can be adjusted by turning a hand valve below the turbocharger.

The pre-start pump for the traction engine operates on a-c power and will operate automatically when the auxiliary generator is operating and the throttle is in IDLE position. This pump will circulate oil at about 80 lbs. pressure. If throttle is in STOP position the pre-start pump will not operate.

Engine driven oil pumps on each engine are mechanically driven and automatically take over the work of the pre-start pumps after the engine fires and normal operating pressures are established. Pre-start pump motors are automatically shut off. If engines stop, pre-start pump motors will automatically start providing electrical power is available.

TRANSMISSION OIL PUMPS

Self-contained oil pumps circulate oil for lubricating the transmission and converter. They are so arranged that lubrication is maintained while being towed.

THIRD RAIL SHOES

Third rail shoes are provided for contacting power supply in third rail zones. They are lowered when operating in third rail zones, and raised at all other times. A third rail switch on the control stand controls magnet valves which determine the position of the shoes. Train-lined electrical circuits connect the magnet valves on both units so that the shoes are raised or lowered from the controlling cab.

The Emergency Shoe Cutout switch and the control stand is used to pneumatically depress third rail shoe away from the third rail. Switch should normally be in OFF position except when moved to SHOE DOWN in emergencies.

THIRD RAIL PROTECTIVE DEVICES

Third Rail Shoe Fuses are installed in a box adjacent to each shoe, space fuse elements are located in the cab of each locomotive.

Meltable Nickel-Chromium Bolts are used to connect the third rail shoe to the operating mechanism. In the event of a

direct ground these bolts will melt permitting the shoe to drop away from the third rail and locomotive.

A special quick acting fuse is installed in the circuit of the auxiliary motor, cabinet (81). Blowing of this fuse will stop auxiliary motor and should be reported to maintenance personnel.

PANTOGRAPH

A pantograph is provided for contacting the overhead rail bridging the third rail gaps in the Grand Central Terminal. It is air elevated, gravity lowered, actuated by a spring-loaded toggle switch located on the control stand adjacent to the headlight switch. This switch must be held closed at all times pantograph is in use. Pantograph is not trainlined and operates only on leading locomotive.

Use pantograph only when necessary to bridge third rail gaps if train speed is insufficient to drift across gap.

COUPLERS

The front of the propulsion unit is equipped with a conventional type coupler for towing.

The rear of the propulsion unit is equipped with an LF-3-A type automatic coupler for connecting to the LM-3-A type automatic coupler on the cars.

The electric portions of the coupler carry the low voltage control and braking circuits to the cars.

The Supervisory Line and Straight Air Pipe connections are also carried through this coupler.

There are several pneumatic portions of the coupler which function to effect the automatic coupling, locking, releasing of the couplers, and deflating of the air spring on the car when uncoupling.

The coupler is also equipped with Steering Lock Pins which mechanically unlock the axle steering mechanism on the car when coupled.

The coupler is operated by a double-acting air cylinder which is actuated by a B-4 type uncoupling valve which is mounted near the coupler and is equipped with a removable handle. This handle is removable in COUPLED-UNCOUPLED position only.

OPERATION

In normal operation, both propulsion units are in operation under the control of the leading cab. The instructions which follow apply to normal operation unless otherwise stated.

PRELIMINARY

Adequate supplies and proper servicing are necessary for the satisfactory operation of the locomotive. **Absolute cleanliness in the oil system, especially in the transmission, is required for reliable operation of the unit.** Be careful that no impurities enter the system when checking oil level or filling the system. Make the following routine inspections on both propulsion units to be sure they are ready for service:

- A. Check supplies of fuel, cooling water, sand, lubricating oil in air compressor, transmission, both engines, and axle drives and clutch between auxiliary engine and A.C. generator.
- B. Check for oil or water leaks. Leaks are more probable on warm equipment under pressure, and should be reported at terminals if observed enroute.
- C. Check that condensate is drained from reservoirs.
- D. Turn on lights if necessary.
- E. Inspect machinery and chassis for worn or loose parts. Check that no tools or rags have been left near moving parts.
- F. Set Multiple Control Switch in leading (controlling) unit in LEADING LOCOMOTIVE position, and when controlled by another unit set switch in TRAILING LOCOMOTIVE position.
- G. Close Battery Switch in the equipment cabinet, check that standby steam and electric lines are disconnected. Check that the following switches are in their normally ON or closed position.

In cabinet (83):

- Traction Engine Lubricating Pump Breaker (TELP)
- Jacket Water Pump Breaker (JWP)
- Intercooler Water Pump Breaker (IWP)
- Battery Charging Control Breaker (BCCB)
- Intercooler Fan Breaker (IF)
- No. 1 Radiator Fan Breaker (F1)
- No. 2 Radiator Fan Breaker (F2)

In cabinet (82):

- Headlight Breaker (HDLT)
- Cab Heater Breaker (CHB)
- Voltage Regulator Cutout Switch (RGCO)
- Transmission Thermometer Cutout Switch (TTCO)
- Lighting Breaker (LTG)
- A.C. Control Breaker (ACCB). See page 51.

In cabinet (81):

- Train Line Control Breaker (TLCB)
- Battery Contactor Control Breaker (BCTB)
- Main Breaker Control Breaker (MBCB)
- Auxiliary Pump Breaker (APB)
- Motor Contactor Control Breaker (MCCB)
- Front Marker Light Breaker (MLF)

H. In cabinet (81) place traction engine control switch (TECS) and traction motor control switch (TMCS) in LEAD AND TRAIL ON position. These switches should be in this position at all times except if it is necessary to isolate an engine or a pair of traction motors.

I. Set air brake equipment as follows:

On Lead Unit, position the Double Heading Cock, located beside the brake valve, in LEAD position, as shown by escutcheon plate.

On Trailing Unit, position the Double Heading Cock in TRAILING position, remove LWL Brake Valve Handle, and lock Parking Brake Valve Handle in RELEASE position.

CONTROL SWITCH

Close Control Switch (breaker) on control stand of the leading unit only. Do not open this switch while engines or motors are to continue operation, otherwise control circuits will shut down, and it will be necessary to repeat the entire starting procedure.

STARTING AUXILIARY ENGINE

Leave the Main Breaker Selector Switch on the auxiliary engine instrument panel in LOCOMOTIVE ONLY position when uncoupled. If already coupled to train place it in LOCOMOTIVE AND TRAIN position. In LOCOMOTIVE ONLY position this switch controls the field of the α -c generator to provide α -c power for locomotive auxiliaries and opens main breaker to isolate the α -c 3 phase circuits between locomotive and train. In LOCOMOTIVE AND TRAIN position it controls the field of the α -c generator and closes the main breaker to provide α -c 3 phase power to the train and remote unit. Place this switch in OFF and RESET position to reset the main breaker if tripped or to isolate the auxiliary engine-generator set for running tests without load.

START LEAD UNIT FIRST

Place Auxiliary Engine Control Switch (AECS) at the fireman's station in the LEAD ON, TRAIL OFF position. Its Auxiliary Engine Off light will go on, and alarm rings, and pre-start lube oil pump starts. Wait until lube oil pressure has reached 25 lbs.

Check fuel oil pressure gauge on equipment cabinet. (84.) Fuel oil pressure should be between 10 and 16 lbs.

Push the Auxiliary Engine Start Button (AESB) at the fireman's station to start the engine. The electrical circuit passes through a number of protective devices which should be checked if the starting motor does not turn. (See paragraph on Protective Devices, page 16.)

Release the button after the light goes out. Engine is now running at 1200 rpm.

Check battery ammeter, a-c voltmeter, and frequency meter to be sure the a-c generator is functioning properly.

Check the air reservoir pressure gauge in left aisle to be sure air compressor is functioning. Auxiliary engine drives compressor at constant speed and it is not possible to change the pumping rate by advancing the throttle.

START TRAILING UNIT

Place Auxiliary Engine Control Switch (AECS) in LEAD AND TRAIL ON position. Its Auxiliary Engine Off light will go on and alarm rings. Wait about one minute for pre-start lube oil pressure to build up in trailing unit (there is no gauge indicating in lead unit).

Press Auxiliary Engine Start Button (AESB). Alarm stops.

Release start button after its light goes out.

Check that Generators In Parallel light has gone out.

STARTING TRACTION ENGINES

Traction engines cannot be started unless one or both auxiliary engines are running.

Place selector handle in ENGINE position.

Place throttle in IDLE position. This starts the traction engine pre-start lube oil pumps of both locomotives. Check that pre-start lube oil pump is operating (pressure gauge on rear cab bulkhead should read about 65 lbs.).

Press Start Button to crank the engines with the starting motor. The electrical circuit passes through a number of protective devices. If the starting motor does not turn refer to Operating Difficulties for a check list of these devices.

Note: The reversing button in IV-h of check list reverses the cranking motor to free a stuck drive. If engine does not crank when start button is pressed, push reversing button momentarily, then try cranking in the usual way.

Release Start Button after lube oil pressure holds steady at about 80-90 lbs., tachometer shows engine speed of 600 rpm. and Traction Engine OFF light goes out.

Note: See bottom page 51 when starting traction engine if train is moving.

STARTING AND STOPPING AUXILIARY MOTORS

This paragraph applies only when starting the auxiliary motor of a shutdown unit whose third rail shoes contact the third rail. (See Fig. 3(b) for Auxiliary Motor Control Switch.)

Start auxiliary motor on leading unit first. Move Auxiliary Motor Control Switch to LEAD ON, TRAIL OFF position. After about 5 seconds, the lead unit motor ON light should burn to indicate that the motor is running.

CAUTION: If main air reservoir air pressure is less than 50 pounds, disengage the clutch before starting the motor by moving the lever on clutch between the auxiliary engine and generator toward generator.

Start auxiliary motor on trailing unit after leading unit is running and main reservoir pressure is above 50 pounds. Start it from the leading cab by moving the auxiliary motor control switch in the leading cab to LEAD AND TRAIL ON position. Trailing unit motor ON light should burn. No manual disengaging of the clutch should be necessary.

To stop auxiliary motors, move Auxiliary Motor Control Switch to LEAD AND TRAIL OFF position.

If only one auxiliary motor is to remain running for standby power move Auxiliary Motor Control Switch to proper position (LEAD ON-TRAIL OFF, LEAD OFF-TRAIL ON).

CAUTION: If only one auxiliary motor is operating see last paragraph of Layover Procedure, page 42.

STARTING AND STOPPING TRACTION MOTORS

With the auxiliary motors started: Insert reverser handle, move throttle handle to IDLE position. Move Power Selector

handle to MOTOR position, Traction motor ON lights will burn. Locomotive is now ready to operate.

To stop motors move Throttle handle to STOP position. Traction Motor ON lights will go off.

MOVING PROPULSION UNIT

Make regular railroad tests on train control and air brakes. Leave the brakes applied and leave the throttle in IDLE position.

Move reverse lever to FORWARD or REVERSE position, depending on desired direction of travel. Do not allow the locomotive to coast or move in the opposite direction, because the transmission will not reverse while driving parts are turning.

Advance the throttle one notch. Both the white and the red transmission lights come on.

The transmission position light comes on only when transmission reversing gears are not in position called for by reverser handle of master controller.

It goes out when the transmission has shifted to the desired direction of travel.

The transmission oil pressure indicator light comes on when the throttle is moved from IDLE to first notch and whenever the converter disengages to permit the transmission to shift between first-second-third-fourth speeds.

If the light does not go out in ten seconds, the traction engine automatically shuts down. To prevent this, return throttle to IDLE before the ten seconds have elapsed.

Release brakes and advance throttle as needed. Gears shift automatically as train speed increases.

If sanding is necessary, pneumatic sanding controls are provided.

INSPECTIONS DURING OPERATION

DO NOT ENTER THE MAIN ENGINE COMPARTMENT WHEN LOCOMOTIVE IS MOVING.

The protective devices which can prevent an engine from starting will also cause the engine to shut down if faulty conditions arise during operation. Temperature and pressure gauges should be checked frequently, and any great deviation from normal should be investigated and reported.

Check voltmeter (480), frequency meter (58-62), fuel oil pressure (8-15 lbs.), auxiliary engine lube oil pressure (90-95), auxiliary engine water temperature (165-190) in auxiliary compartment.

Check turbocharger oil drip sight gauges on both engines. (See page 9 and 11 for flow rate.) Traction engine turbocharger sight gauge may be observed from small doors in right-aisle.

Check traction engine lube oil pressure (75-90), main circulating water temperature (165-190), and transmission oil temperature at cab bulkhead (240-275).

Turn filter cleaning levers on lube oil filters on both engines to remove dirt from filter inserts. (Traction engine levers to be turned only when locomotive is stopped.)

INDICATOR LIGHTS

In addition to the lights previously mentioned, the following indications guide operators.

Generators-not-in-parallel (on fireman's gauge panel)—check Main Breaker Selector Switch on electrical instrument panel of both locomotives to see that it is in LOCOMOTIVE AND TRAIN position, check that Main Breaker has not tripped, or check overload lights below.

Overload Lights—on the electrical instrument panel show when breakers have tripped or an overload has occurred in the circuits to the auxiliary motor or traction motors. Reset buttons immediately below the indicating light reset the affected circuit. Trailing unit overload indication is not carried to the leading unit but loss of auxiliary motor or traction motors will be indicated in leading cab by auxiliary motor and traction motor ON lights going out.

EMERGENCY GEAR SHIFT

A manual emergency reverser and gear shift are provided to enable the operator to control the transmission if the automatic control fails. All operating levers for emergency control are located on the top of the control box cover (refer to Fig. 9). The controls can be reached through the trap door in the operating cab.

Emergency operation of reverser only, gear shifting only, or both, is possible, depending on what portion of the control system fails. Always examine the starting magnets and reversing magnets (items 5 and 6) before using the manual emergency controls. Open the spring loaded cap of the magnets to see whether they respond when the cab controls are moved.

Manual operation of the starting and reversing magnets is possible if they do not respond to the cab controls.

The manual emergency reverser is to be operated only when the propulsion unit is at a standstill and the engine shut down. Press the handle (item 3) firmly downward until it is released from its notch and then turn it to the required direction of travel. Arrows indicate direction of travel. The handle must rest firmly in the notch in its new position. The engine is restarted in the normal manner.

The manual emergency gear shift can be operated after moving the control selector handle (item 2) from "automatic" (AUTOMATIK) to "emergency operation" (NOTBETRIEB). Press the control selector handle downward until it is released from its notch and turn it until it rests firmly in the notch in its new position. If the handle cannot be turned readily to its new position with the engine running, it should be turned with the engine shut down. The engine is restarted in the normal manner.

With the control selector handle in the "emergency operation" position, gear shifting can be done by means of the manual emergency gear shift (item 1). The speed of the propulsion unit should not exceed the maximum speed for

that gear shift setting. As the maximum speed is reached, shift into the next setting.

Gear Setting	Maximum Speed
1	26 MPH
2	43 MPH
3	70 MPH
4	120 MPH

Depending on what portion of the control system fails, it may not be possible to shift from one gear setting to another while the propulsion unit is moving. In this event, the manual emergency gear shift lever must be left in one gear setting. Use only gear settings 1, 2 or 3. It is advisable to use the lower gear setting 1 or 2. Do not exceed the maximum speed for that gear setting. Do not attempt to start the propulsion unit with the number 4 gear setting.

When shutting down the engine after manual emergency operation of the transmission, always return the manual emergency gear shift to gear setting 1, return the control selector handle to "automatic" and reverser selector to the neutral position.

STOPPING PROPULSION UNIT

Normally, move the throttle to IDLE position, and move the "LWL" brake valve handle into the application zone.

To make an emergency stop, move the "LWL" brake valve handle to FULL AUTOMATIC APPLICATION position, which results in a full electro-pneumatic brake application plus a full supervisory type automatic brake application. Power is automatically shut off and traction engine idled. The throttle must be moved to IDLE position before power can be restored.

REVERSING PROPULSION UNIT

Come to a full stop before moving the reverse lever when reversing the direction of movement. Move reverse lever and follow all instructions given in a previous paragraph for moving the propulsion unit.

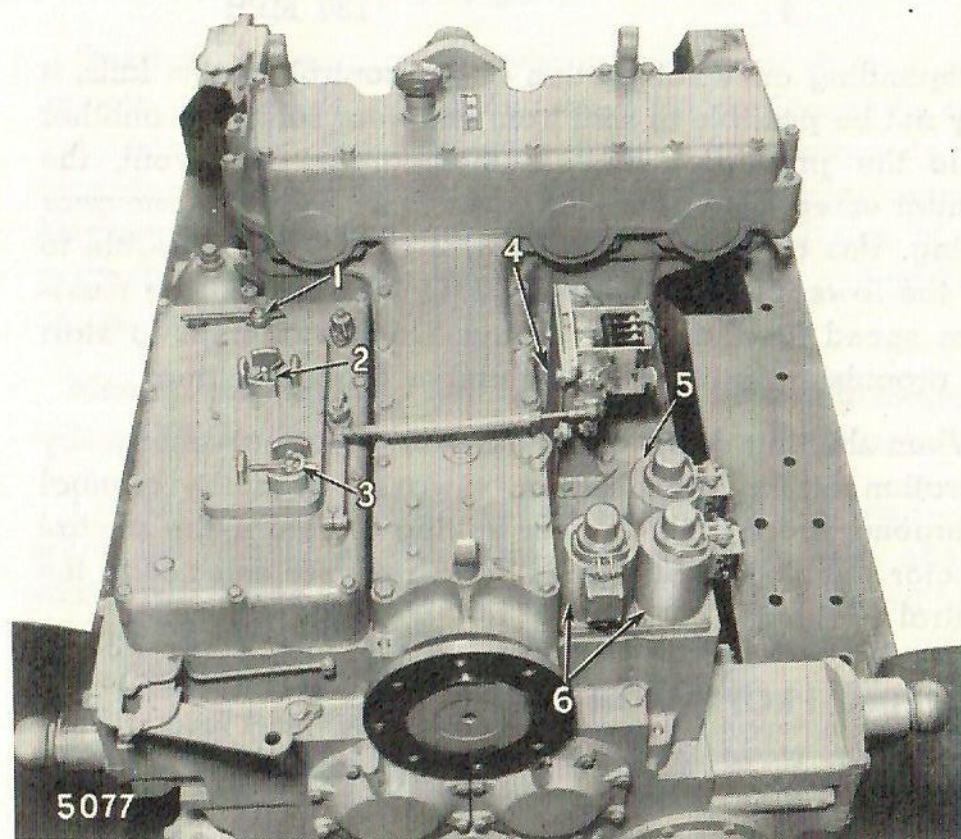


FIG. 9. MANUAL EMERGENCY TRANSMISSION CONTROLS

- | | |
|------------------------|----------------------------------|
| 1. GEAR SHIFTING LEVER | 4. TRANSMISSION INTERLOCK SWITCH |
| 2. CONTROL SELECTOR | 5. STARTING MAGNETS |
| 3. REVERSE LEVER | 6. REVERSING MAGNETS |

SHUTTING DOWN PROPULSION UNIT

To stop main engine only, for short layovers, move the throttle to IDLE position for three minutes to dissipate heat, then move to STOP position. If desired to circulate oil through main engine by the pre-start lube oil pump, return throttle to IDLE position as soon as engine has stopped.

To stop both the main engine and auxiliary engine, for long layovers, move throttle handle to STOP position, turn Auxiliary Engine Control Switch to LEAD OFF-TRAIL OFF position and open the control switch at the control stand.

To stop motors in third rail terminals see page 33.

For emergencies, an engine stop solenoid on each engine is linked to the governor on the engines. Pressing the shaft under the cap of the solenoid will shut down the engine. On the auxiliary engine, a lever on the front of the governor can be lifted to stop the engine.

Open Battery Switch when both engines are stopped for long layover. Turn out lights to avoid draining battery.

CHANGING CONTROL STATIONS

To change control from one end of the train to the other end, as in a stub end terminal or similar track movement, the unit which has been the leading unit becomes the trailing unit, and the unit which has been the trailing unit becomes the leading unit. Air and electrical equipment must be reset to meet these various conditions. All engines will shut down, and on third rail trackage all motors will stop. Four sets of instructions follow, viz.:

- A. Changing Leading Unit to Trailing Unit under diesel engine power.
- B. Changing Trailing Unit to Leading Unit under diesel engine power.
- C. Changing Leading Unit to Trailing Unit on third rail track.
- D. Changing Trailing Unit to Leading Unit on third rail track

A. In the unit which has been Leading, with diesel engine running.

1. Move Throttle to STOP position.
2. Remove Reverse Lever.
3. Turn Auxiliary Engine Control Switch to LEAD AND TRAIL OFF position.
4. Open Control Switch on Control Stand.
5. Make Full Automatic (Emergency) brake application.
6. Position Double Heading Cock in TRAILING position.
7. Open Air Brake Circuit Breaker on Control stand.
8. Move Automatic Brake Valve Handle to RELEASE position and remove.
9. Lock Parking Brake Valve Handle in RELEASE position.
10. Change Multiple Unit Control Switch in equipment cabinet (81) to TRAILING LOCOMOTIVE position.

This cab is now set for trailing operation.

B. In the unit that has been Trailing.

1. Place Multiple Unit Control Switch in LEADING LOCOMOTIVE position.
2. Check that Throttle is in STOP position.
3. Insert Reverse Lever.
4. Close Control Switch.
5. Unlock Parking Brake Valve Handle.
6. Insert Brake Valve Handle and move to FULL SELF-LAPPING position to release Full Automatic (Emergency) application.

Note: Full electro pneumatic brake application is retained during the change over until the LWL Brake Valve Handle is moved to RELEASE position.

7. Close Air Brake Circuit Breaker on Control Stand.

8. Position Double Heading Cock in LEAD position.

9. Start Auxiliary Engines and Traction Engines, as previously directed.

This cab is now set for leading operation.

C. In the Unit which has been Leading on the third rail track.

1. Move Throttle to STOP position, remove Reverse Lever.
2. Turn Auxiliary Motor Control Switch to LEAD AND TRAIL OFF.
3. Place Selector Handle in ENGINE position.
4. Place 3rd rail shoe Control Switch in OFF position.
5. Open Control Switch on control stand.
6. Set-up air brake as in items A-5-6-7-8-9, page 40.
7. Place the Multiple Unit Control Switch in TRAILING LOCOMOTIVE POSITION.

This cab is now set for trailing operation.

D. In the Unit which has been Trailing.

1. Place the Multiple Unit Switch in LEADING LOCOMOTIVE position.
2. Close Control Switch.
3. Place 3rd rail shoe control switch in shoe DOWN position.
4. Set-up air brake as items B-5-6-7-8, part B.
5. Place Auxiliary Motor Control Switch in LEAD ON, TRAIL OFF position. (Starts Auxiliary motor on this unit.) See Page 33.
6. Place Auxiliary Motor Control Switch in LEAD AND TRAIL ON position. (Starts Auxiliary motor on other unit.)
7. Insert Reverse Lever, move throttle to IDLE position.
8. Place Selector Handle in MOTOR position. (Both traction motors start.)

This cab is now set for leading operation.

LAYOVER PROCEDURE

During a layover period, the propulsion unit cooling water system should be maintained at 130° F. by means of a standby steam line, as previously described or by electric immersion heaters.

1. Connect the terminal standby steam line to the steam line connection at the right rear of the propulsion unit. Temperature can be controlled by cracking the steam line valve to regulate the amount of steam admitted.
2. Plug in wayside power. It must be 220 volt, 3 phase, 60 cycle.
3. Close wayside Control Breaker (WCB).
4. Check that the Intercooler Water Pump circuit breaker (IWP) and Battery Charging Control Breaker (BCCB) are closed.
5. Check that pump is rotating in proper direction. To change rotation of a 3 phase motor, the leads in the shop circuit have to be reversed. It is, therefore, advisable to have regularly assigned sources of standby power.

If an a-c generator is driven by either the auxiliary motor or auxiliary engine, standby heating can be obtained electrically from a-c immersion heaters instead of from steam. One generator can feed heaters on both locomotives if the other generator is shutdown.

CAUTION: If only one generator is being driven by its auxiliary motor, half the elements in the immersion heater of both units must be cut out by opening heater switch (IHS) on the rear radiator bulkhead.

TO TOW PROPULSION UNITS

Set-up each propulsion unit as follows:

Shutdown the main engine. (Auxiliary engine may continue to run.) Neutralize control stand, except that Control Switch must stay closed if an auxiliary engine is to continue operating.

Remove reverse lever and electro-pneumatic brake valve handle, and lock the parking brake valve handle in RELEASE position.

Place the Double Heading Cock on the Leading Propulsion Unit, located in the cab at the engineer's station, in LEAD position; the Double Heading Cock on the trailing propulsion unit should be placed in TRAILING position. These handle positions are indicated by an escutcheon plate.

Position the two dead engine cocks, located in the nose, in DEAD position, as shown on escutcheon plates.

Set feed valve pressure on towing locomotive to 110 lbs.

Connect the brake pipe hose on the towing locomotive to the Supervisory Line of the propulsion unit, and open angle cocks on both towing and towed locomotives.

The towing locomotive can now charge the Supervisory Line System throughout the train, and an automatic application on the towing locomotive will give a straight air application on the train, or an electro-pneumatic type application if the Air Brake Breaker is closed and battery power is available.

When towing train and propulsion unit from a car end, the propulsion unit is set up for towing in the usual manner. The towing locomotive brake pipe is connected to the Supervisory Line Hose, therefore any automatic brake application from the towing locomotive will result in a Full Automatic (Emergency) brake application on the train. It is therefore suggested that, when practical, this type of movement be controlled by use of the independent brake on the towing locomotive, and the automatic brake be applied only in emergency.

COUPLING PROPULSION UNIT TO CARS

1. Set car hand brake on one or two cars, or block car wheels.
2. Move propulsion unit to within approximately 2 feet of car coupler and check that car coupler is within gathering range of propulsion unit coupler.

3. Check that B-4 Uncoupling Valve on propulsion unit is in COUPLED-UNCOUPLD position (handle removed). Refer to Fig. 8.
4. If car air springs are inflated, operate the Deflation Valve (HD-5-A) handle, Figure 8, to deflate the air springs and hold until coupling is effected.
5. Operate parking brake valve to retain approximately 15 lbs. brake cylinder pressure.
6. Back propulsion unit against car with parking brake on, until coupling contact is effected, then move throttle to IDLE, leaving parking brake on. During the automatic operation of the coupler, following contact, the red light near the Uncoupling Valve will light, and remain lighted until the coupling is complete. If the red light does not light, electrical trouble should be corrected. If light does not go out, the couplers are not locked and the coupling procedure should be repeated.
7. Release Deflation Valve handle and air springs will automatically inflate.
8. Open Supervisory Line cut-out cock on both propulsion unit and car.
9. Release hand brakes or remove blocking from cars.
10. Move main breaker control switch on electrical instrument panel to LOCOMOTIVE AND TRAIN position.

UNCOUPLING PROPULSION UNIT FROM CAR

1. Apply parking brake.
2. Move main breaker control switch on electrical instrument panel to LOCOMOTIVE ONLY position.
3. Set hand brakes on one or two cars, or block wheels.
4. Close Supervisory Line cut-out cock on both propulsion unit and car.
6. Insert uncoupling valve handle and move to UNCOUPLING position; car air springs will automatically deflate. During the automatic operation of the coupler which

follows, the red light near the Uncoupling Valve will light, and remain lighted until the uncoupling is complete. If the red light does not light, electrical trouble should be corrected. If the red light does not go out, the couplers are not uncoupled and the uncoupling procedure should be repeated.

7. Release parking brake and move propulsion unit away from train.
8. Move uncoupling valve handle to COUPLED-UNCOUPLD position and remove handle.

NOTE: Coupling and uncoupling should always be done on straight track. Three-phase a-c power circuits automatically make contact when the train is coupled.

ENTERING THIRD RAIL ZONE

- A. To change from traction engine to motor drive:

Lower 3rd rail shoes before entering 3rd rail zone.

Move throttle handle to IDLE position.

Move Selector Handle to motor position. Engines should stop and after approximately 5 seconds both traction motor ON lights should burn.

After ON lights indicate motors are running, power is applied by moving throttle handle to position 1.

Power and speed may be increased by moving throttle to position 2 or 3. Maximum motor speed is obtained in position 3. (ON lights flicker off briefly when throttle is advanced.)

Use pantograph as necessary to bridge third rail gaps inside Grand Central Terminal if locomotive speed is low.

- B. To change from auxiliary engines to auxiliary motors:

Move Auxiliary Motor Control Switch from LEAD AND TRAIL OFF position to LEAD AND TRAIL ON position.

After both auxiliary motor running lights are burning, move Auxiliary Engine Control Switch to LEAD AND TRAIL OFF position.

LEAVING THIRD RAIL ZONE

A. To change from auxiliary motors to auxiliary engines:

Start lead unit auxiliary engine. See page 31.

Start trailing unit auxiliary engine.

Move Auxiliary Motor Control Switch to LEAD AND TRAIL OFF position. This shuts off power to auxiliary motors, and their lights go out.

B. To change from motor drive to diesel engine:

Move throttle handle to IDLE position.

Move Selector Handle to ENGINE position. Motors should stop, motor ON lights should go out, traction engine OFF lights should burn, alarm bell rings and traction engine pre-lube pumps start.

Wait until pre-lube oil pressure has built up then press traction engine start button. Alarm bell should stop ringing.

Hold start button down until both traction engine OFF lights are out, and engine tachometer shows normal operation. Then release button.

Apply power to locomotive by advancing throttle to positions 1 to 6.

Raise 3rd rail shoes after leaving 3rd rail zone.

OPERATING DIFFICULTIES

1. Auxiliary Engine Does Not Turn When Starting Button Is Pressed.

- a. Weak battery.
 - a. Check battery, recharge if necessary.
 - b. Manually operated switches in the electrical circuit are open.
 - b. Check that battery switch (equipment cabinet 83), auxiliary engine control switch (Fireman's control panel), and control switch (cab) are closed.
 - c. Faulty electrical circuit.
 - c. Check for loose connections and that automatically operated starting relay and switches (equipment cabinet) are making good contact.
 - d. Insufficient pre-start lube oil pressure.
 - d. Check that pre-start lube oil pumps are operating, and gauge pressure is 25 lbs. or more on main oil system, 180 lbs. on governor oil line.
 - e. Automatic protective switches open.
 - e. Check that auxiliary engine jacket water temperature is not excessive.
- Check that A.C. circuit breakers supplying power to the fans, water, and oil pumps are closed.

II. Auxiliary Engine Does Not Continue Running After Releasing the Start Button.

- a. No fuel.
 - a. Check fuel tank, emergency shut-off valve, fuel pressure gauge (to determine if pump is delivering) and filters.
- b. Air in fuel.
 - b. Open vent screw on fuel line on engine and vent if necessary.
- c. Air intake shut off.
 - c. Check overspeed stop damper position.
- d. Engine lube oil pump has not built up sufficient pressure.
 - d. Keep start button pressed until pressure reaches 90 lbs. and light goes out. If unable to realize 90 lbs. pressure, lube oil pump is defective.

48

III. Auxiliary Engine Stops.

- a. Protective devices items I-e and II-c have functioned.
 - a. As noted previously.

IV. Main Engine Does Not Turn When Start Button Is Pressed.

- a. Auxiliary engine is not running.
 - a. Start auxiliary engine.
- b. Insufficient pre-start lube oil pressure.
 - b. Check pre-start pump motor, circuit breaker and A.C. power supply (A.C. voltmeter and frequency meter).

- c. Throttle in incorrect position.

- c. Must be in IDLE position.

- d. Automatic protective switches open.

- d. Check that main engine jacket water temperature is not excessive.

Check that A.C. circuit breakers supplying power to the fans, water and oil pumps are closed.

- e. Transmission oil hot.

- e. Check transmission temperature indicator (panel back of cab) if tripped press FREE button, Fig. 3(a).

- f. Transmission thermometer cut-out switch open.

- f. Close cut-out switch (equipment cabinet 82).

- g. Overspeed stop has tripped.

- g. Reset.

- h. Bendix drive not engaging.

- h. Press reversing button in power compartment, right aisle, to free. Check for excessive dirt on drive shaft.

49

V. Main Engine Does Not Continue Running After Releasing the Start Button.

- a. Engine lube oil pump has not built up sufficient pressure.
 - a. Keep start button pressed until pressure builds up to 80-90 lbs. and light goes out. If unable to realize this pressure, lube oil pump is defective.

- b. Air in fuel line.

- b. Open vent screw on fuel line and vent if necessary.

VI. Main Engine Stops.

- a. Protective devices items IV-d, IV-e and IV-g from above have functioned.
- b. Auxiliary engine has stopped.
- c. Transmission shifting interval exceeds time limit.
- a. As noted previously.
- b. Restart auxiliary engine.
- c. Refer to Transmission Oil Pressure Switch, page 20.

VII. Propulsion Unit Does Not Respond to Controls.

- a. Propulsion unit does not move.
 1. Brakes applied, release brakes.
 2. Reverse lever OFF, move to FORWARD or REVERSE.
 3. Transmission starting magnet not energized. Refer to Emergency Gear Shift, page 36.
- b. Propulsion unit does not reverse.
 1. Transmission reversing magnets not energized, check white transmission indicating light. Refer to Emergency Gear Shift, page 36.
 2. Transmission reversing system does not function. Refer to Emergency Gear Shift, page 36.
 3. Transmission automatic controls defective. Refer to Emergency Gear Shift, page 36.
- c. Transmission does not shift gears.

VIII. A.C. Generator Voltage Zero or Fluctuating. (See Note 2.)

- a. Voltmeter reads "zero."
- b. Voltage fluctuates erratically.
- c. Breaker ACCB has tripped open.
- a. Check that circuit breaker (ACCB) is closed.
- b. Open voltage regulator cut-out switch (RGCO) in cabinet and see if condition improves. Only temporary emergency operation should be undertaken with this switch open.
- c. Place Main Breaker Control Switch to "Loco only" position and see if condition is corrected.
- d. Check auxiliary engine governor for hunting.
- e. Try resetting breaker.

IX. Main A.C. Breaker Does Not Close. (See Note 2.)

- a. Control circuit defective.
- a. Check that Main Breaker Control Breaker (MBCB) is closed. If this does not rectify close Main Breaker manually.

NOTE: 1. To start main engine when train is moving faster than 50 MPH, set throttle handle in second or third notch, and follow instructions on page 32. Below 50 MPH, place throttle in IDLE position.

2. Corrective checks on Items VIII and IX should only be done when auxiliary engines are not in parallel.

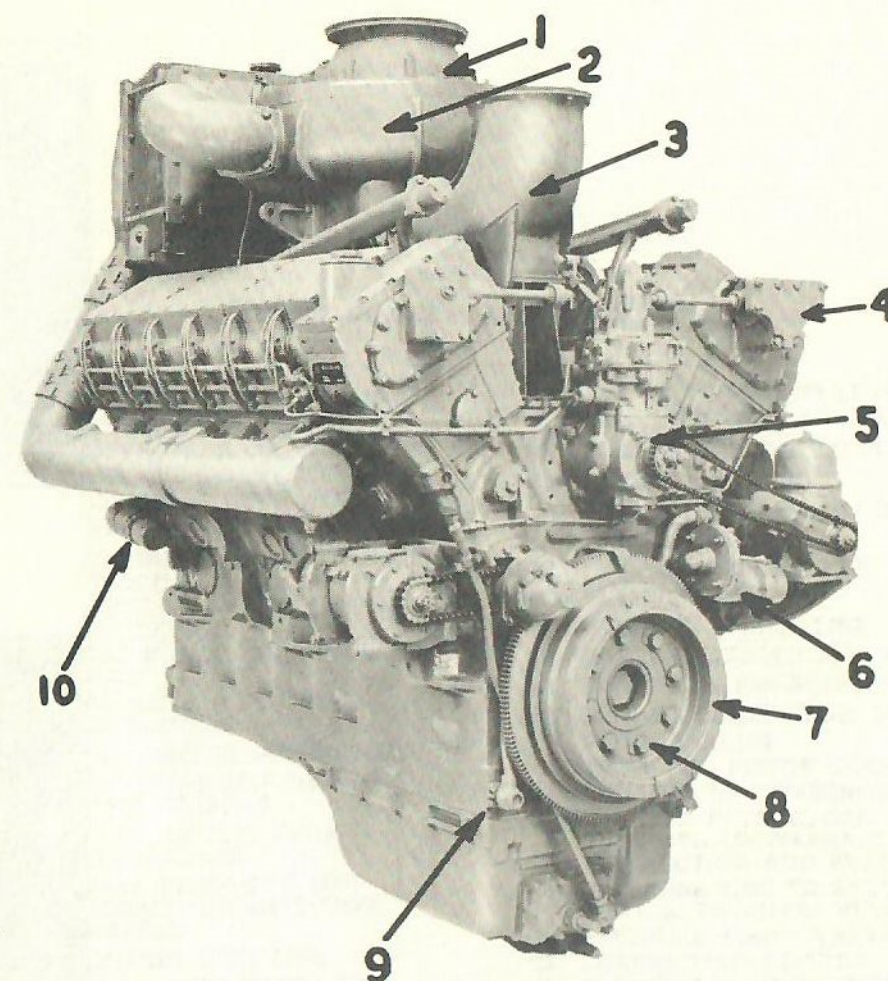
CAUTION: DO NOT CLOSE MAIN BREAKER MANUALLY TO PARALLEL GENERATORS.

INDEX

	PAGE
Air Brakes	24
Air Compressor	23
Alternating Current Generator	11
Auxiliary Engine	10, 31
Auxiliary Engine Instrument Panel	5, 8
Axle Drive	10
Battery	12
Battery Ammeter	16
Battery Charging	12
Battery Switch	14, 29, 39
Bendix Drive	32
Brake System	24
Breaker Type Switches	5, 14, 15, 16
Cab Controls	5, 8
Circuit Breakers	5, 14, 15, 16
Compressor, Air	23
Conductors Emergency Valve	25
Control Switch	5, 31
Cooling System	21
Couplers	28, 43, 44
Coupling Procedure	43, 44
Deflating Valve	28, 44
Double Heading Cock	30, 40, 43
Drains, Water	21
Electrical Equipment Cabinets	12
Electrical Instrument Panel	16
Emergency Transmission Gear Shift	36
Emergency Shoe Down Switch	27
Engine, Auxiliary	10
Engine Data	2
Engine Emergency Stop	39
Engine, Traction	9
Engine Oil Pumps	25, 27
Engine Starting, Auxiliary	31
Engine Starting Relays	20
Engine Starting, Traction	32
Excitation (Emergency)	51

Fans	23
Fan Contactors	15
Frequency Meter	16, 19
Fuel Oil Pump	25
Fuel Oil Shut-Off Valve	20
Fuse (Battery Charging)	12
Gauge Readings	35
Gear Shifting (Transmission)	10, 36
General Data	1
Generator	11
Headlight	16
Indicator Lights	8, 9, 20, 35
Inspections (Operating)	35
Instrument Panel (Auxiliary Engine)	5, 8, 31
Intercooler Water Pump	21, 42
Layover Procedure	42
Lighting Circuits	16
Lube Oil Switches	(See Oil)
Main Breaker Selector Switch	31, 44
Multiple Unit Switch	14, 29, 40, 41
Oil Filters Cleaning Levers	9, 11, 35
Oil Level Gauges	9, 10, 11
Oil Pressure Switch, Engines	18
Oil Pressure Switch, Transmission	20
Oil Pumps	25, 27
Oil Temperature Switch, Transmission	18
Operating Difficulties	47
Overload (Lights)	35
Overspeed Trips	10, 18
Pantograph	28
Power Knockout	8, 25
Power Selector Handle	8
Power Truck Compartment	4
Pre-start Pumps	25, 27, 31, 32, 39
Protective Devices	16, 17, 27
Pumps	21, 25, 27

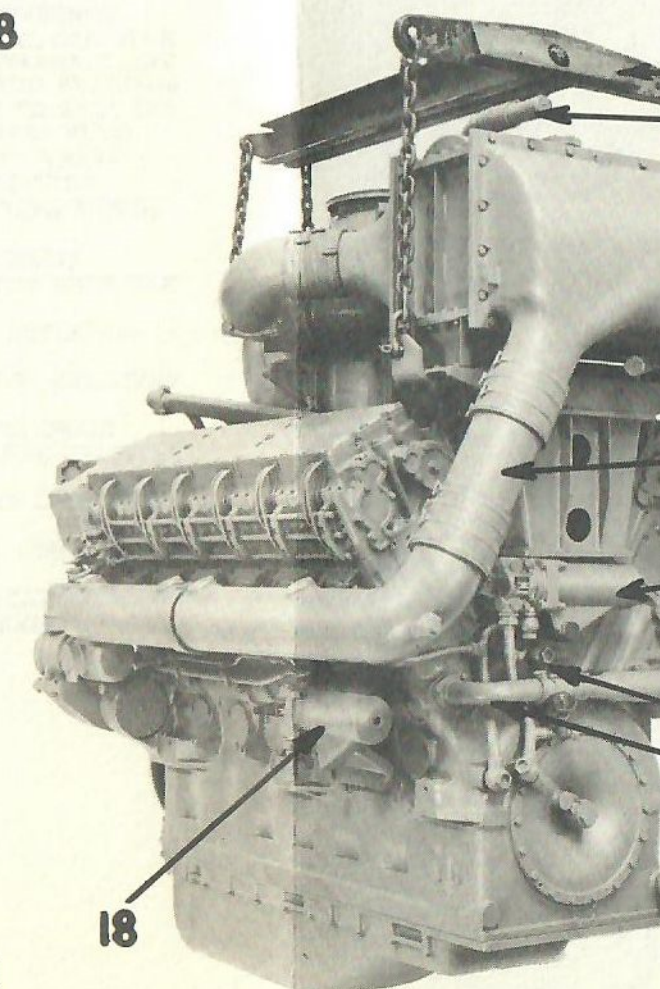
Radiators	23
Reverse Lever	5
Reversing Magnets, Transmission	36
Safety Control (Air)	25
Sanding	34
Selector Handle	8
Shutters	23
Standby Connections	12, 21, 42
Standby Immersion Heating	23, 42
Starting Magnets, Transmission	36
Stop Solenoid (Engine Governor)	10, 11, 39
Third Rail Changeover	45, 46
Third Rail Protective Devices	27
Third Rail Shoes	27
Third Rail Switch	8, 27
Throttle Lever	5
Towing	42
Traction Engine	9, 32
Traction Motors	33
Train Line Air Circuits	24, 28
Train Line Electrical Circuits	3, 28
Transmission	10
Transmission Check and Cutout Switches	18
Transmission Oil Pressure Switch	20
Transmission Oil Pumps	27
Transmission Shifting Light	20
Turbocharger Sight Gauge	9, 11, 35
Uncoupling Valve	28, 43, 44
Vent (Fuel Line)	9, 11, 20
Voltage Regulator	14, 51
Voltmeter	16, 32, 35
Water Drains	21
Water Fill and Gauge	21
Water Pumps	21, 42
Water Temperature Switch, Engine	18
Wayside Breaker (Battery Circuit)	12, 42



M0602

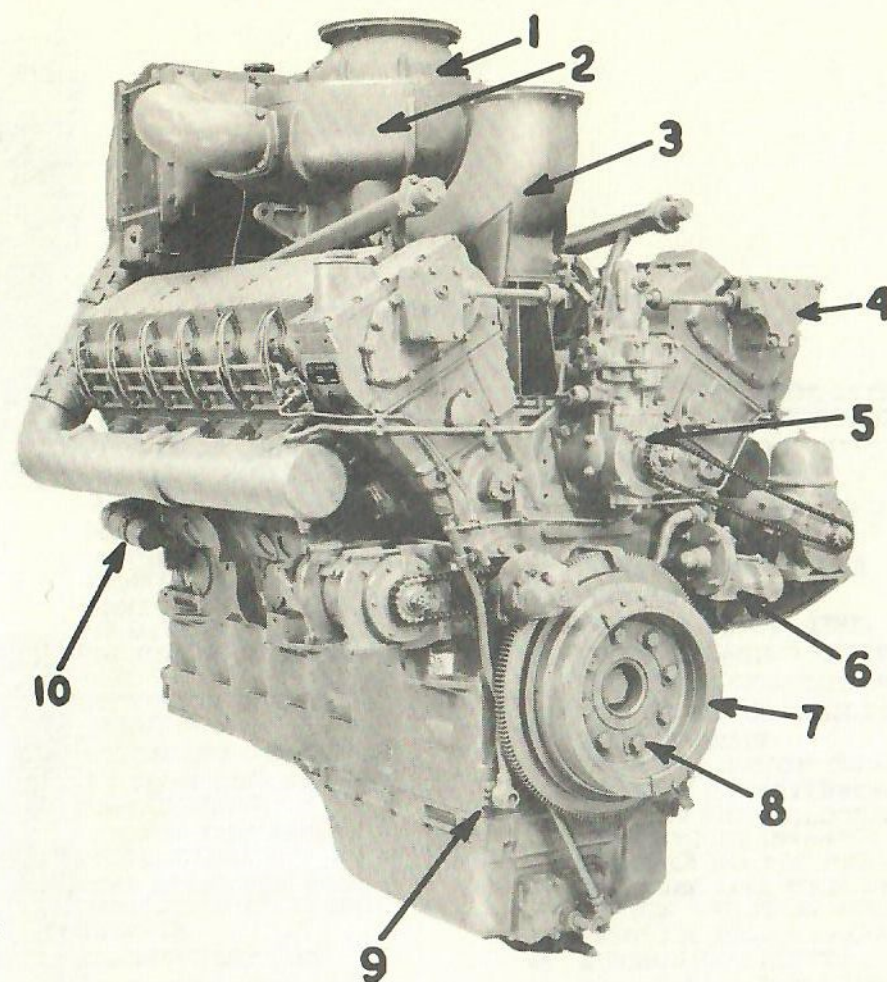
TYPE MD-655 ENGINE

1. AIR INTAKE
2. TURBOCHARGER AGL-123
3. EXHAUST PIPE
4. BRACKET FOR FUEL OIL
5. ENGINE GOVERNOR R3G
6. ADAPTOR WITH DRIVE FOR TACHOMETER GENERATOR OVERSPEED TRIP
7. FLEXIBLE COUPLING
8. CONNECTION FOR DRIVE
9. OIL LINE TO MAIN LUBE FILTER
10. COOLING WATER INLET
11. ENGINE LIFTING DEVICE



M0601

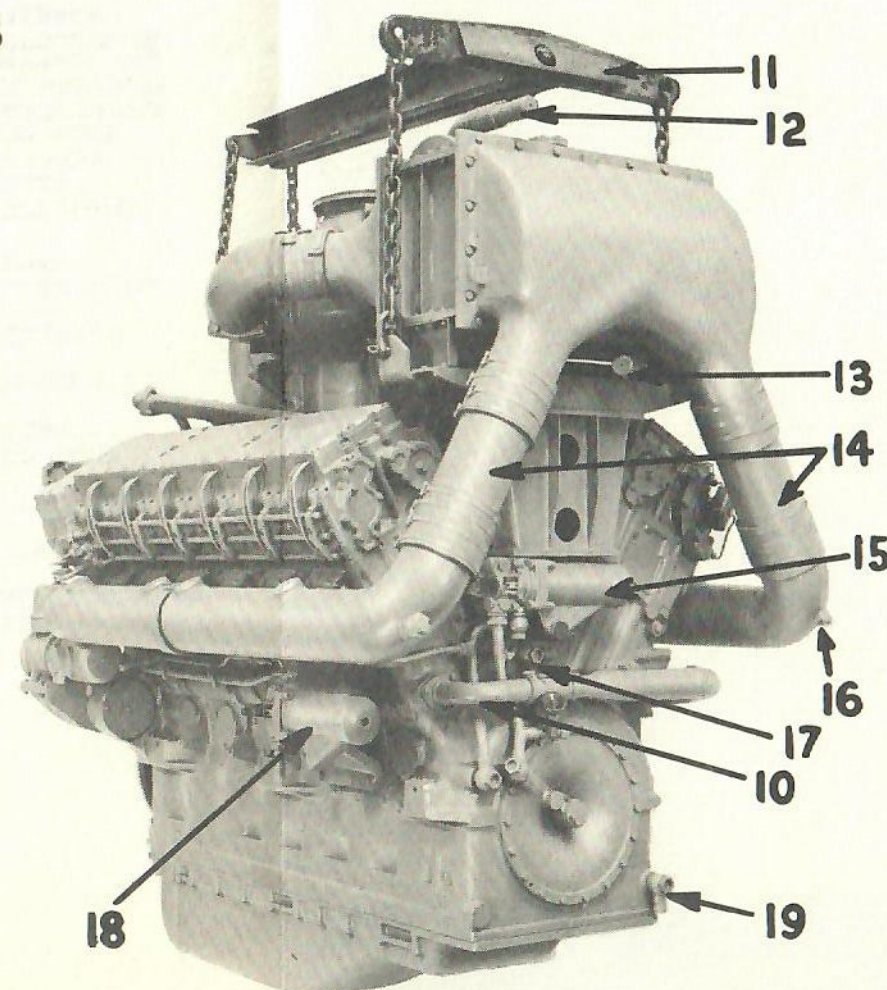
.....	23
.....	5
mission	36
.....	25
.....	34
.....	8
.....	23
..... 12, 21, 42	
g	23, 42
ssion	36
vernor)	10, 11, 39
.....	45, 46
es	27
.....	27
..... 8, 27	
.....	5
.....	42
..... 9, 32	
.....	33
..... 24, 28	
its	3, 28
.....	10
utout Switches	18
Switch	20
.....	27
t	20
..... 9, 11, 35	
.....	28, 43, 44
..... 9, 11, 20	
..... 14, 51	
..... 16, 32, 35	
.....	21
.....	21
..... 21, 42	
l, Engine	18
Circuit)	12, 42



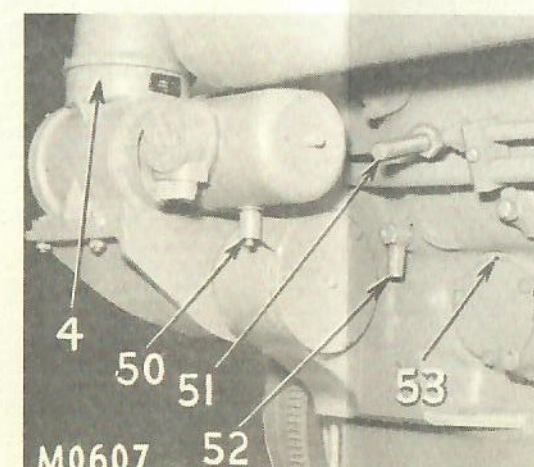
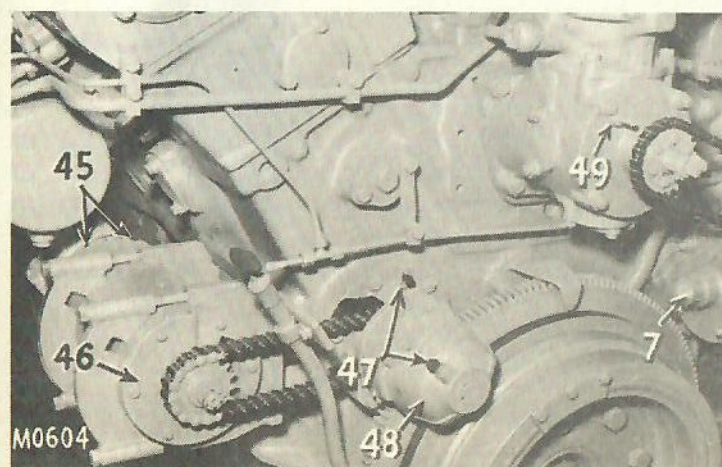
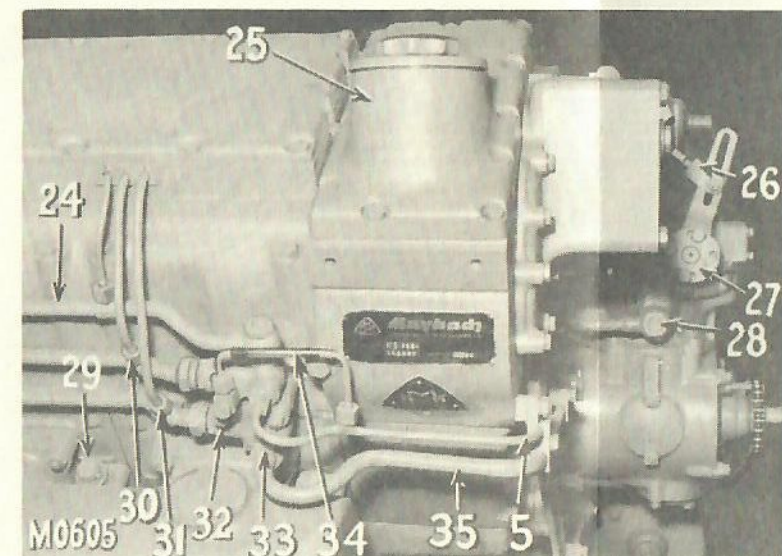
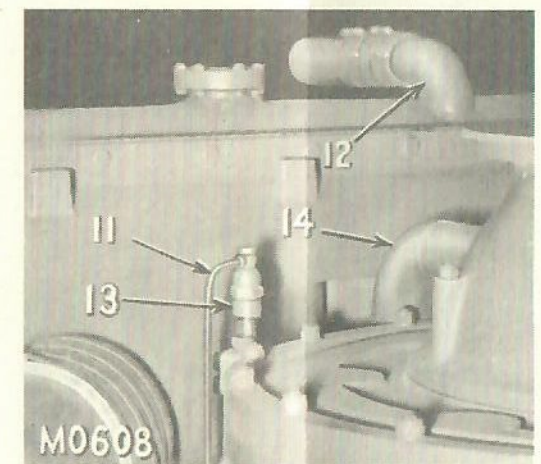
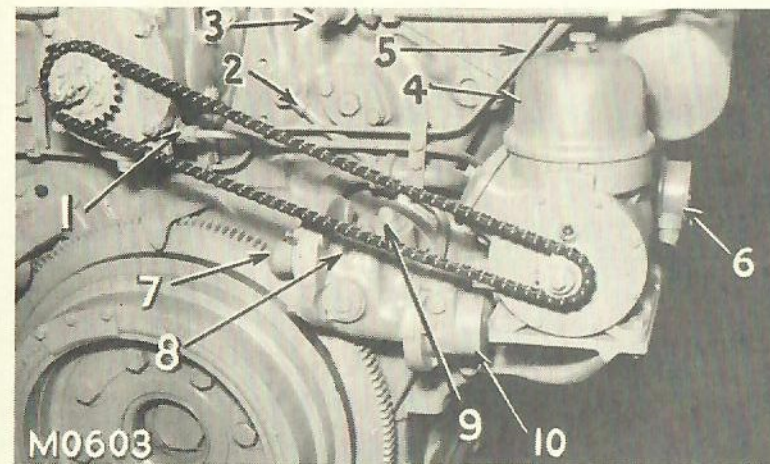
M0602

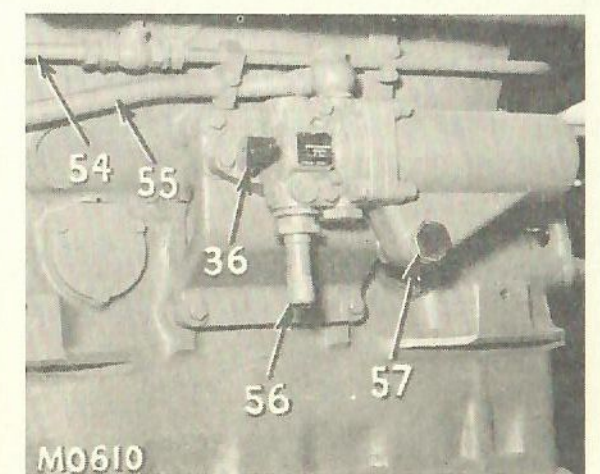
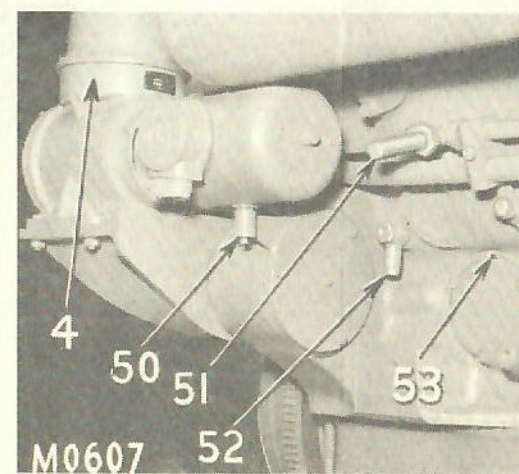
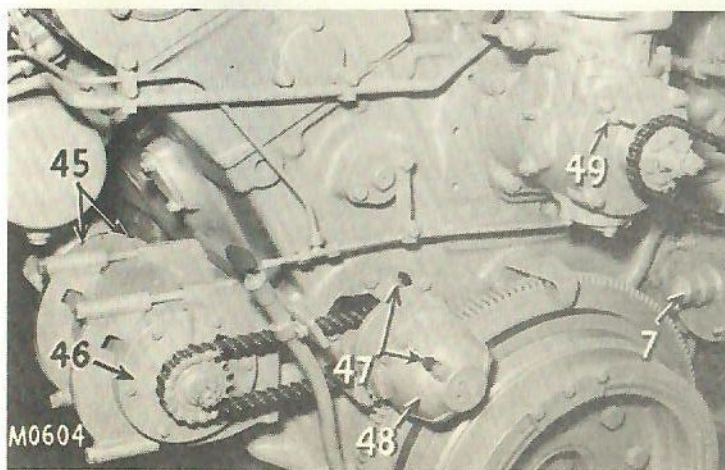
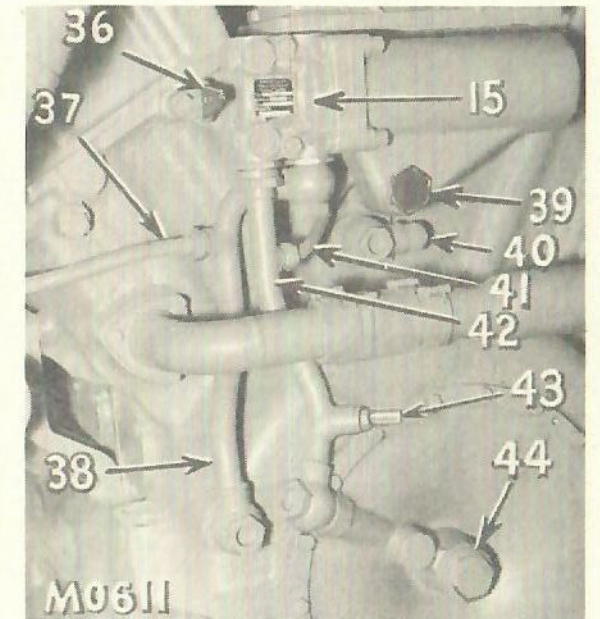
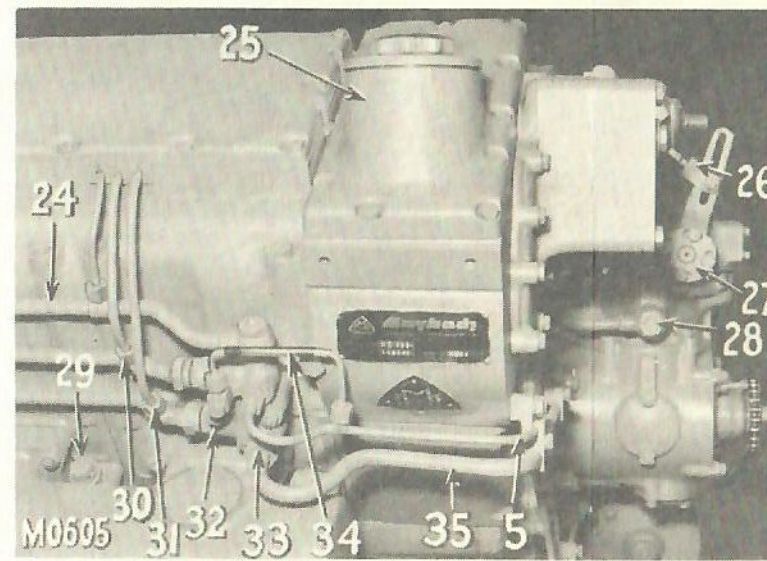
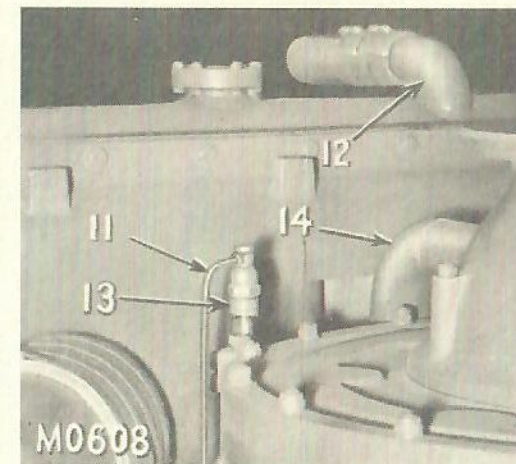
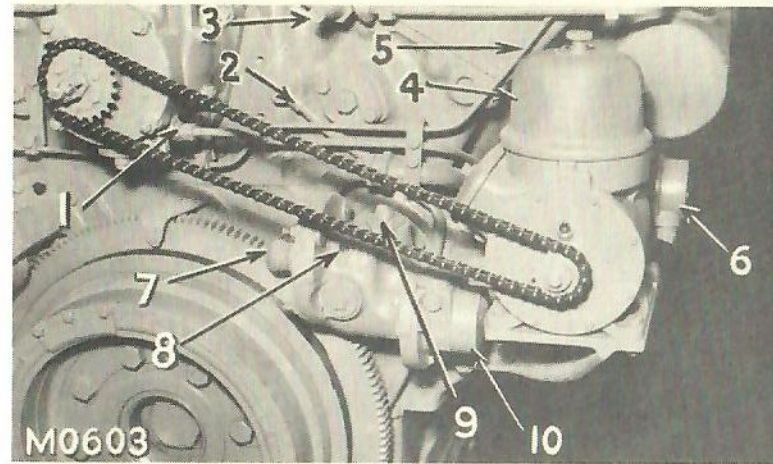
TYPE MD-655 ENGINE WITH TURBOCHARGER AND INTERCOOLER

- | | |
|---|---|
| 1. AIR INTAKE | 12. WATER OUTLET FROM INTERCOOLER |
| 2. TURBOCHARGER AGL-123 | 13. WATER INLET TO INTERCOOLER |
| 3. EXHAUST PIPE | 14. AIR INLET PIPES |
| 4. BRACKET FOR FUEL OIL FILTER | 15. CLOSE-MESH FILTER FOR CRANKSHAFT AND CONNECTING ROD BEARING LUBRICATING OIL |
| 5. ENGINE GOVERNOR R3G | 16. GAUGE CONNECTION FOR TURBOCHARGER PRESSURE |
| 6. ADAPTOR WITH DRIVE FOR TACHOMETER GENERATOR AND OVERSPEED TRIP | 17. PISTON COOLING OIL INLET FROM HEAT EXCHANGER |
| 7. FLEXIBLE COUPLING | 18. MAIN LUBRICATING OIL FILTER |
| 8. CONNECTION FOR DRIVE SHAFT | 19. PISTON COOLING OIL OUTLET TO HEAT EXCHANGER |
| 9. OIL LINE TO MAIN LUBE OIL FILTER | |
| 10. COOLING WATER INLET | |
| 11. ENGINE LIFTING DEVICE | |

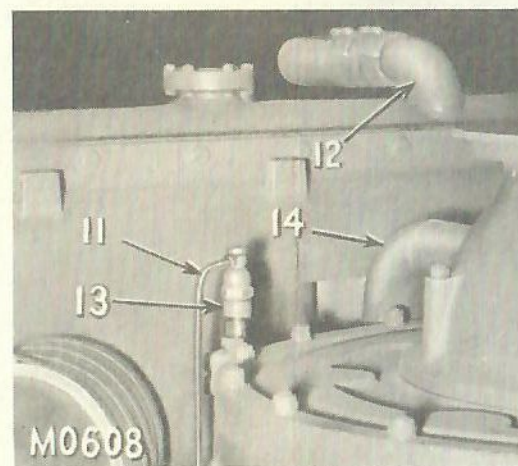
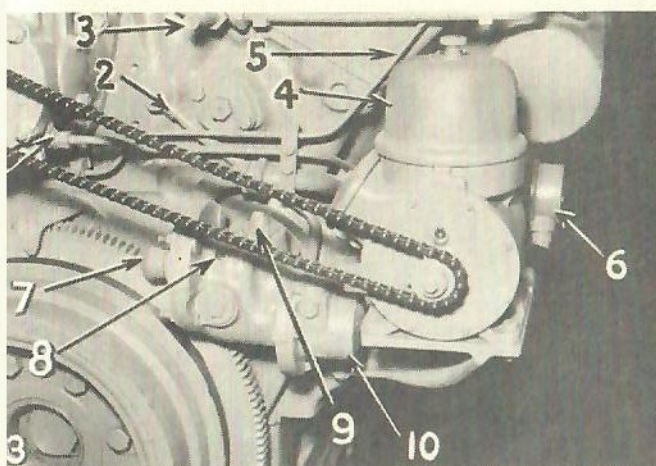


M0601





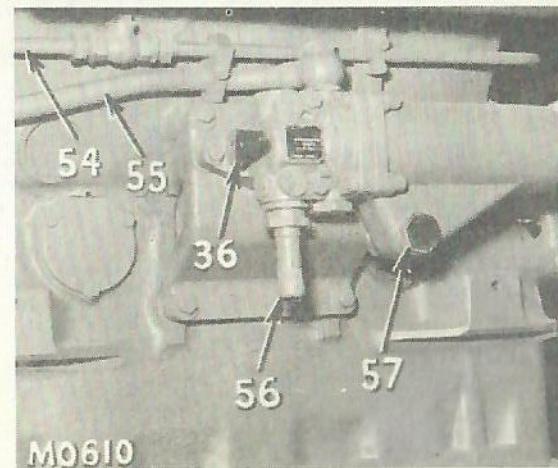
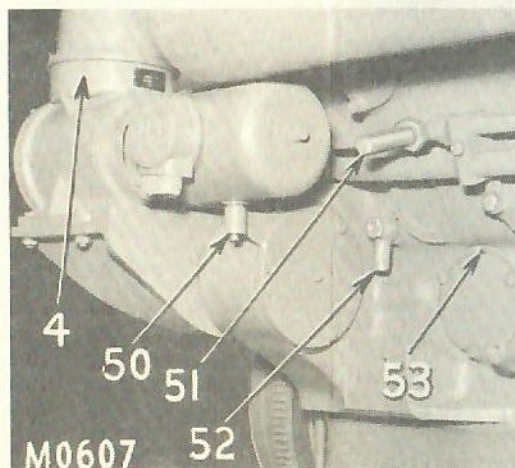
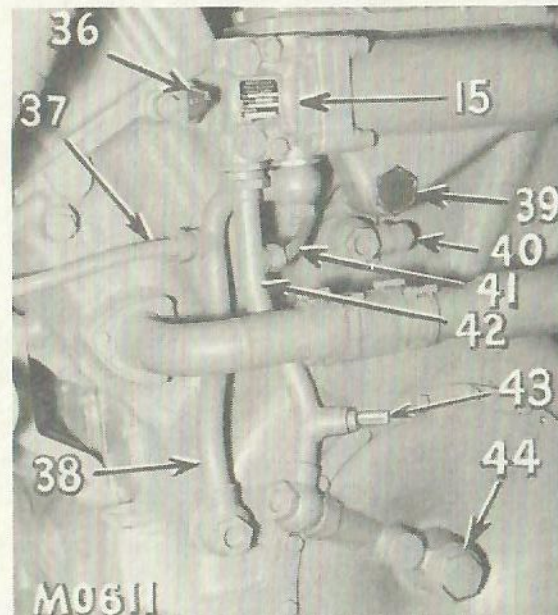
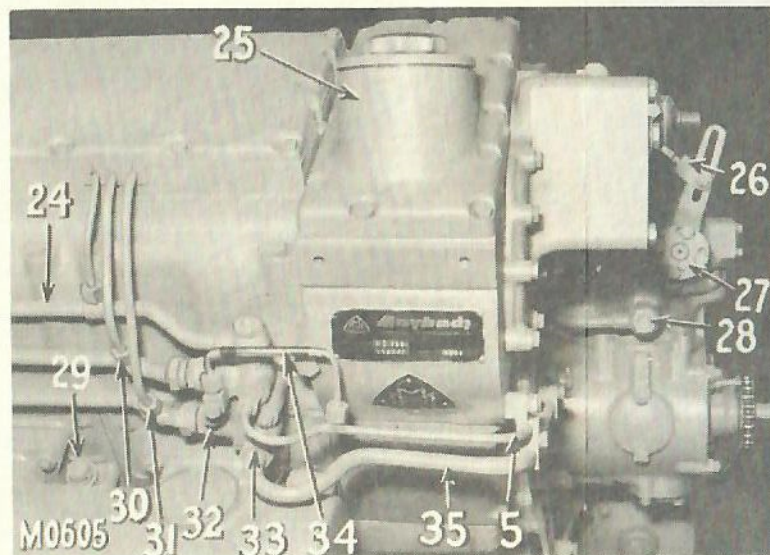
1. O
2. S
3. V
4. F
5. G
6. H
7. E
8. T
9. C
10. T
11. L
12. D
13. R
14. C
15. T
16. L
17. T
18. W
19. I
20. S
21. L
22. C
23. H
24. C
25. C
26. R

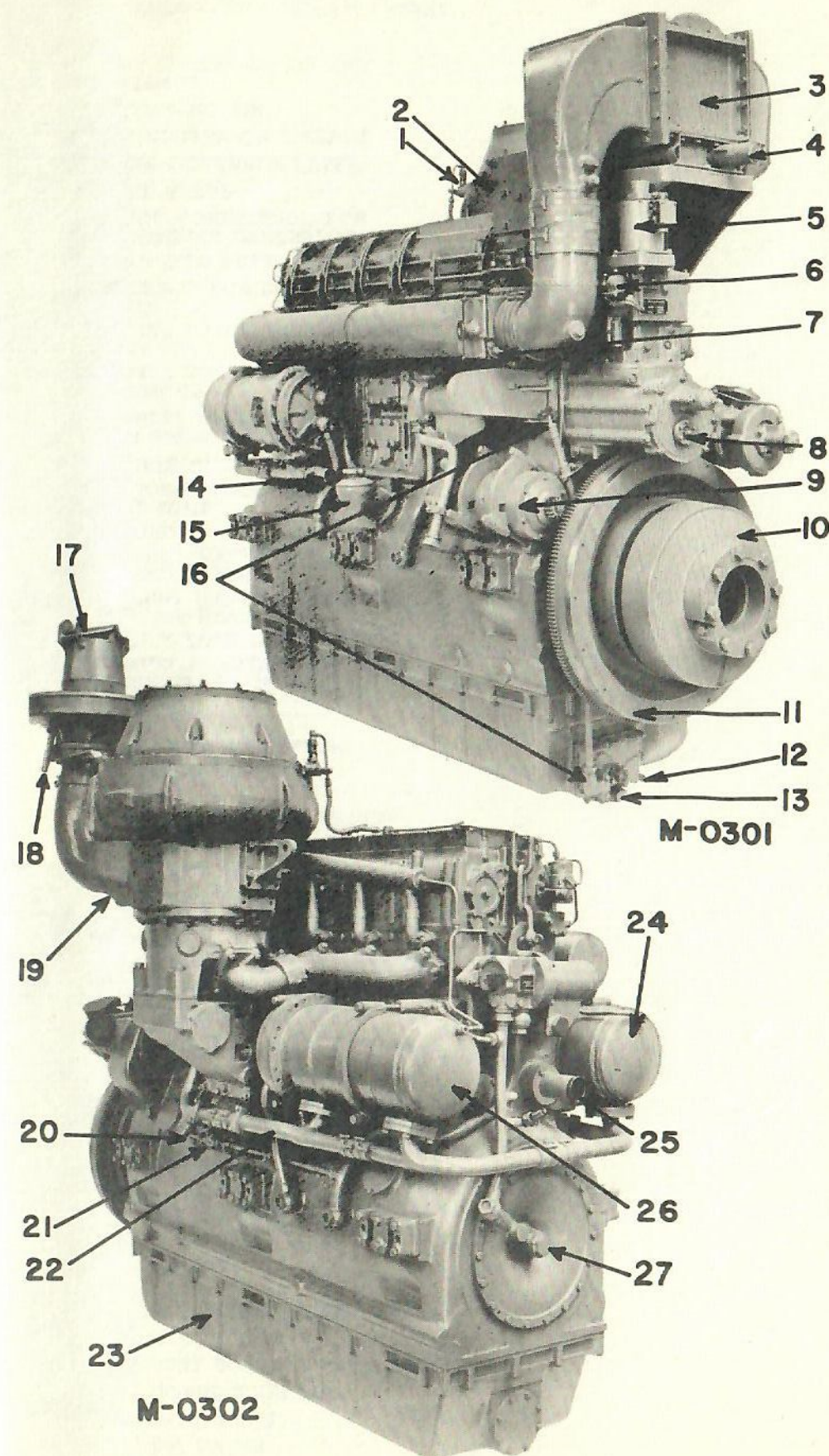


EXTERIOR DETAILS — TYPE MD-655 ENGINE

1. OIL CONNECTION TO LIMIT STARTING FUEL DELIVERY
2. VALVE GEAR OIL LINE
3. FUEL OIL CONNECTION
4. GOVERNOR ACTUATOR
5. HEADER FOR LEAK-OFF FUEL
6. ELECTRICAL CONNECTION FROM THROTTLE
7. CONNECTION FOR OVERSPEED TRIP DEVICE
8. LUBE NIPPLE, TACHOMETER DRIVE
9. REVOLUTION COUNTER CONNECTION
10. TACHOMETER GENERATOR
11. LINE FROM DRIP-OILER TO TURBOCHARGER
12. WATER OUTLET FROM INTERCOOLER
13. SIGHT GLASS FOR DRIP LUBRICATION OF TURBOCHARGER
14. HOUSING VENT LINE
15. CLOSE-MESH FILTER FOR CRANKSHAFT AND CONNECTING ROD BEARING LUBRICATING OIL
16. CONNECTING LINK
17. FILLING LEVER SCALE (FUEL DELIVERY READING)
18. POSITIONING PIN
19. LUBE NIPPLE, GOVERNOR SHAFT
20. GOVERNOR FEMALE SPLINE SHAFT
21. GOVERNOR MALE SPLINE SHAFT
22. DRIP-OILER FOR TURBOCHARGER LUBRICATION
23. PRESSURE RELIEF VALVE FOR VALVE GEAR OIL
24. FUEL LEAK-OFF LINE
25. OIL FILL
26. LINKAGE

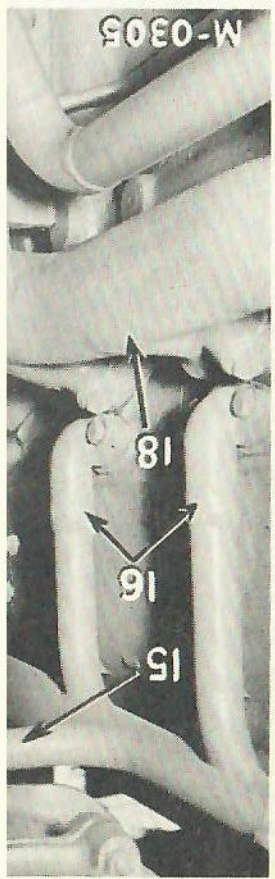
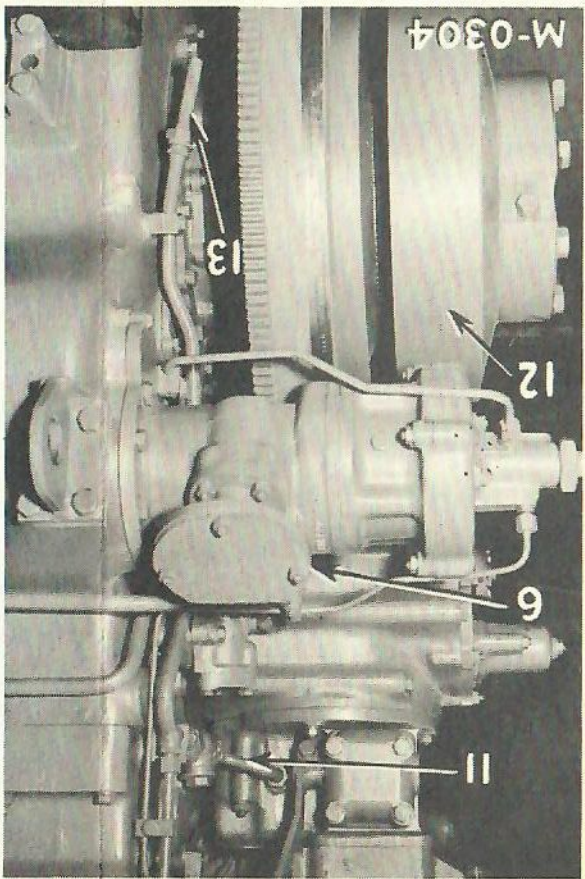
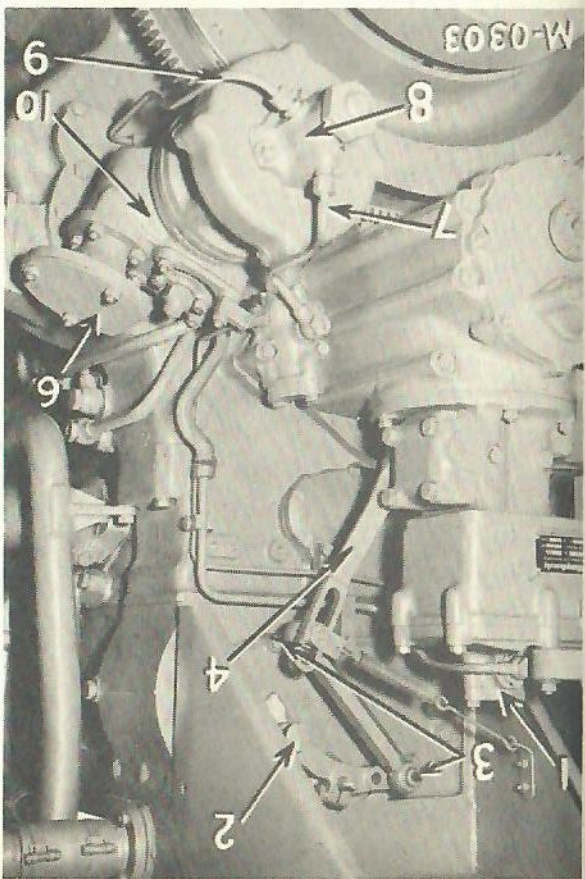
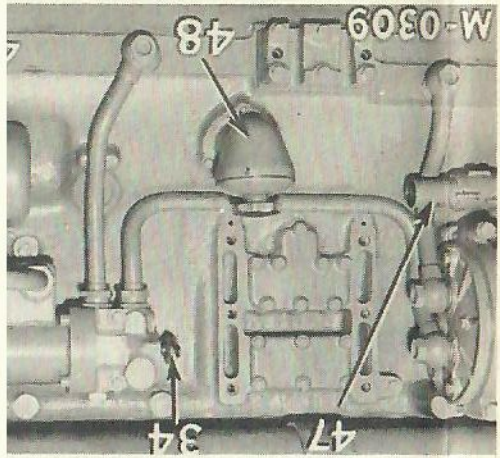
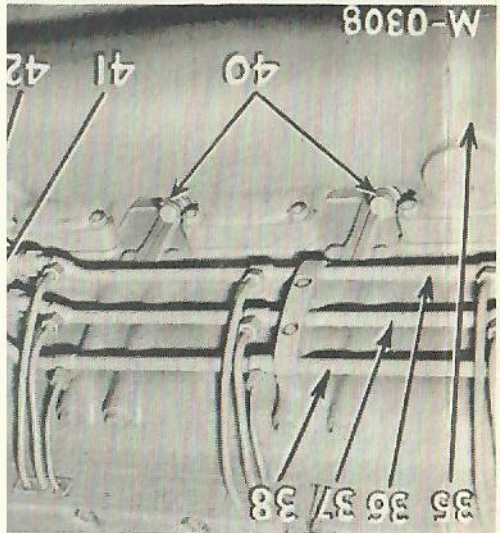
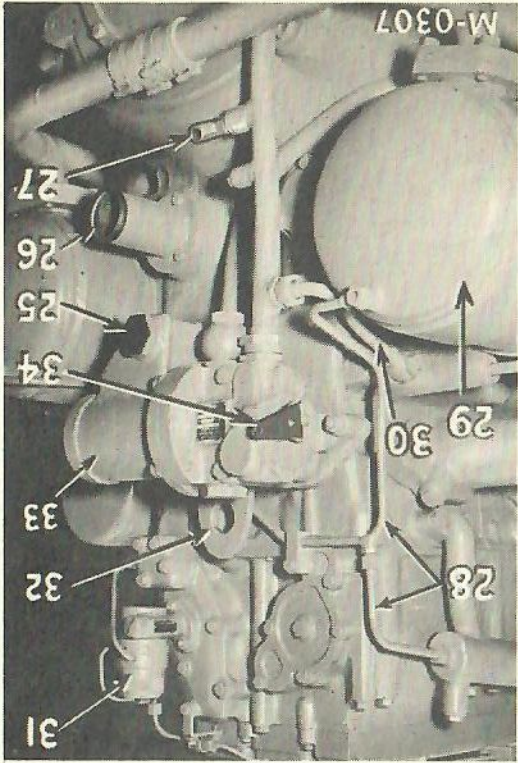
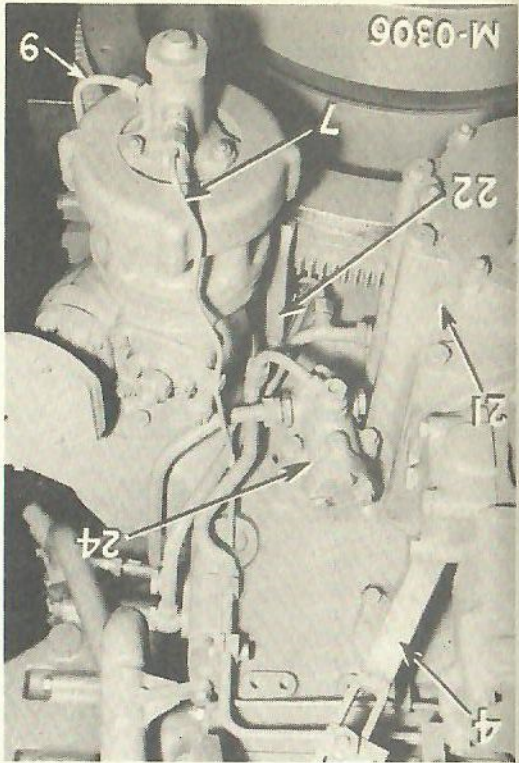
27. ACTIVE GOVERNOR LEVER
28. INLET FOR GOVERNOR OIL
29. DECOMPRESSION VALVE
30. FUEL RETURN LINE
31. FUEL SUPPLY LINE TO INJECTOR
32. VENT SCREW
33. FUEL OIL DISTRIBUTOR
34. PLASTIC HOSE
35. FUEL OIL SUPPLY LINE
36. FILTER CLEANING LEVER
37. LINE FROM PRE-START PUMP
38. LINE TO CLOSE-MESH OIL FILTER
39. SLUDGE DRAIN
40. INLET FOR PISTON COOLING OIL
41. OIL LINE TO GOVERNOR
42. OIL LINE FROM CLOSE-MESH FILTER TO CRANKSHAFT AND CONNECTING ROD BEARINGS
43. PRESSURE LINE TO SHUT-OFF DEVICE, PRE-START PUMP
44. PRESSURE RELIEF VALVE
45. LUBRICATING POINTS
46. ELECTRIC STARTING MOTOR
47. OIL CUPS
48. STARTER GEAR DRIVE
49. CONNECTION FOR SHUT-OFF SOLENOID
50. SUPPORT FOR GOVERNOR ACTUATOR
51. CONNECTION FOR PRE-START PUMP
52. HOUSING WATER DRAIN
53. RELIEF BORES FOR CYLINDER LINER SEALS
54. PRE-START PUMP LINE WITH CHECK VALVE
55. LINE FROM OIL CIRCULATING PUMP
56. TO LUBE OIL HEAT EXCHANGER
57. OIL SLUDGE DRAIN

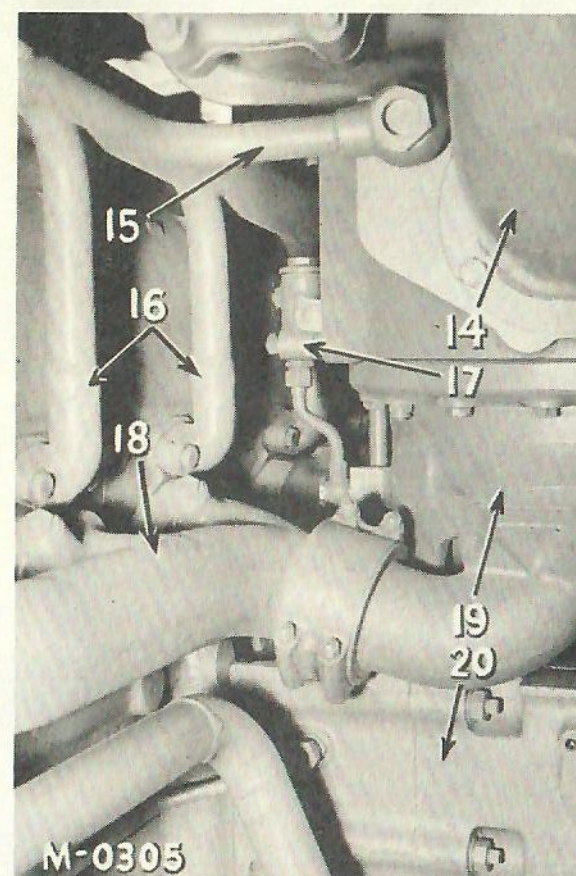
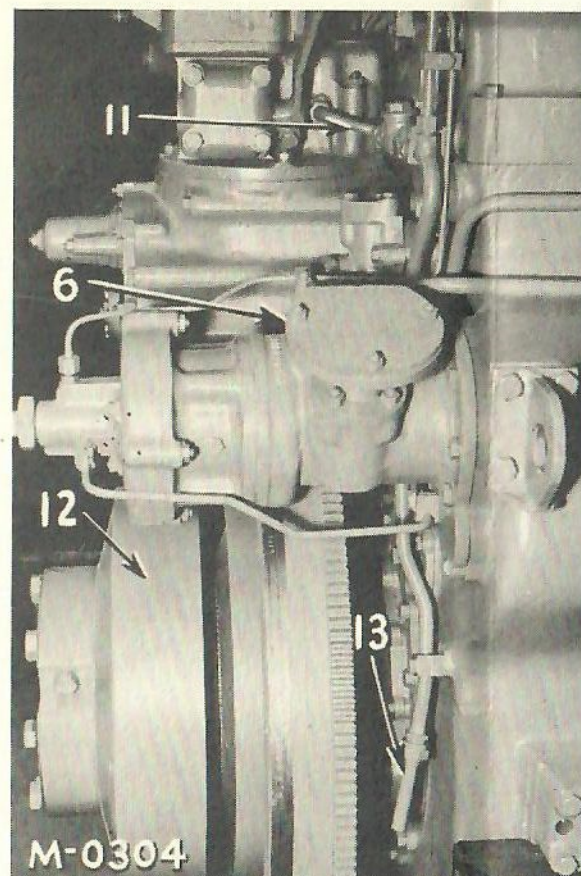
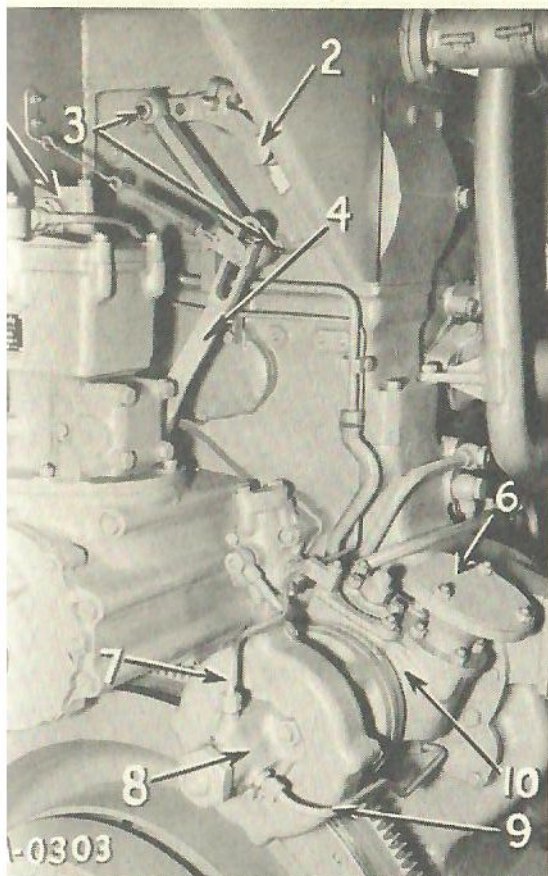




TYPE MD-330 ENGINE WITH TURBOCHARGER AND INTERCOOLER

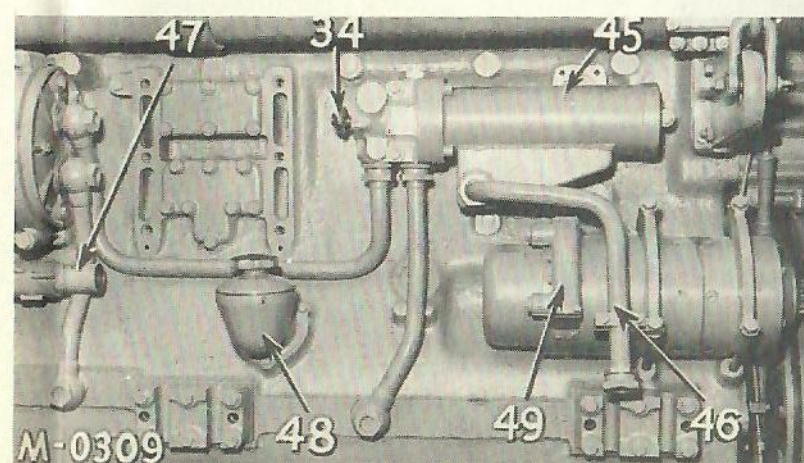
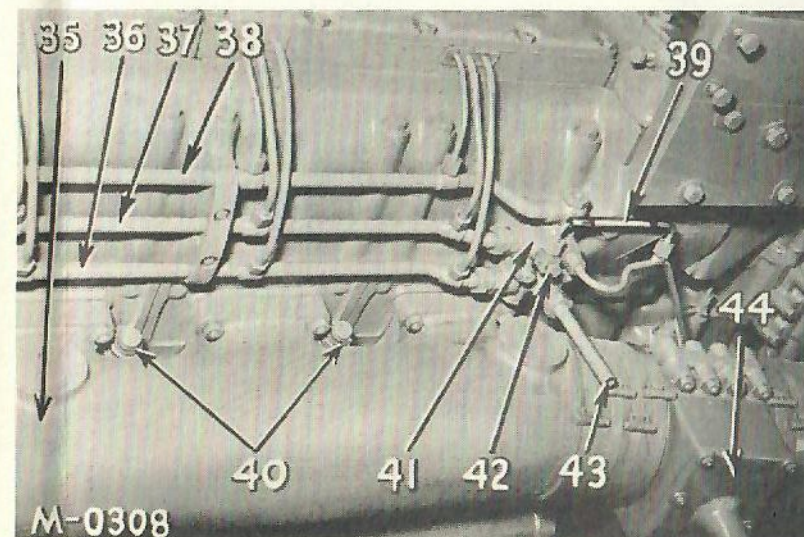
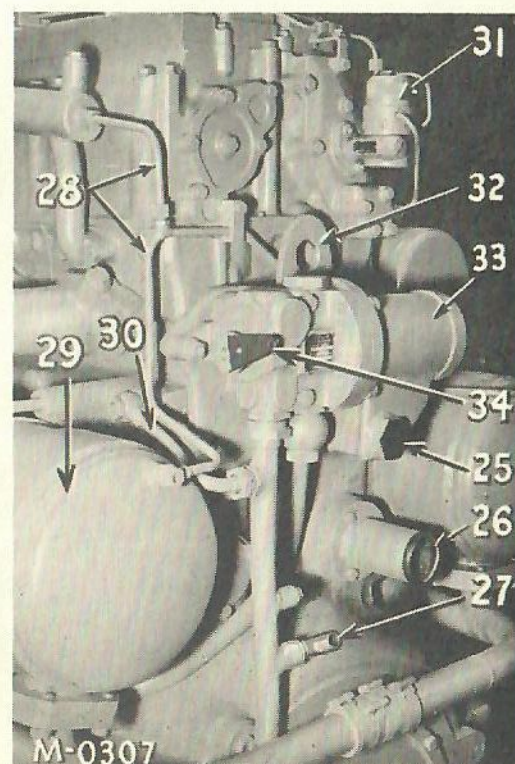
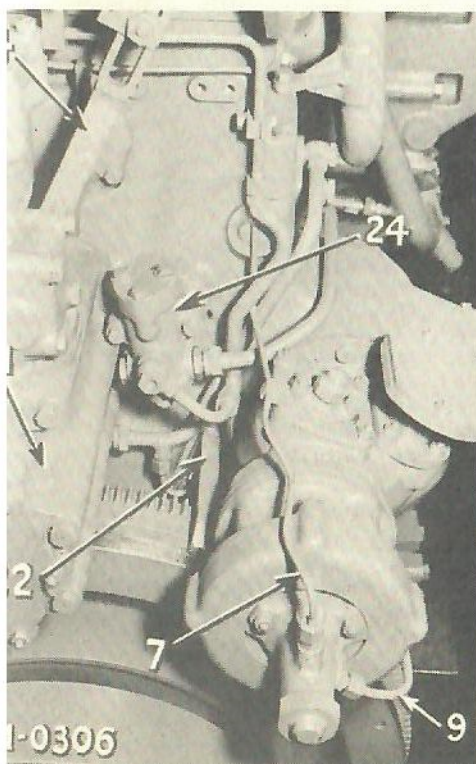
1. OIL CONNECTION ON TURBOCHARGER WITH SIGHT GLASS
2. BRACKET FOR FUEL OIL FILTER
3. INTERCOOLER
4. COOLING WATER INLET TO INTERCOOLER
5. SHUT-OFF SOLENOID
6. EMERGENCY SHUT-OFF LEVER ON R4G GOVERNOR
7. OIL CONNECTION ON BUTTERFLY VALVE
8. CONNECTION TO GOVERNOR ACTUATOR
9. ELECTRIC STARTING MOTOR
10. FLEXIBLE COUPLING
11. FLYWHEEL WITH TIMING MARKS AND RING GEAR
12. OIL DRAIN CONNECTION
13. CONNECTION FOR PRE-OIL PUMP
14. COOLING WATER INLET FROM EXPANSION TANK
15. OIL FILL
16. OIL DIP STICK AND TUBE
17. EXHAUST OUTLET WITH RAIN SHIELDS
18. DRAIN PIPE FOR RAIN WATER
19. TURBOCHARGER
20. ENGINE WATER DRAIN
21. CHECK VALVE IN PRE-START PUMP LINE TO CLOSE-MESH OIL FILTER
22. COOLING WATER HEADER FROM HEAT EXCHANGERS
23. OIL PAN
24. HEAT EXCHANGER FOR LUBRICATING OIL
25. ENGINE COOLING WATER INLET
26. HEAT EXCHANGER FOR PISTON COOLING OIL
27. PRESSURE RELIEF VALVE

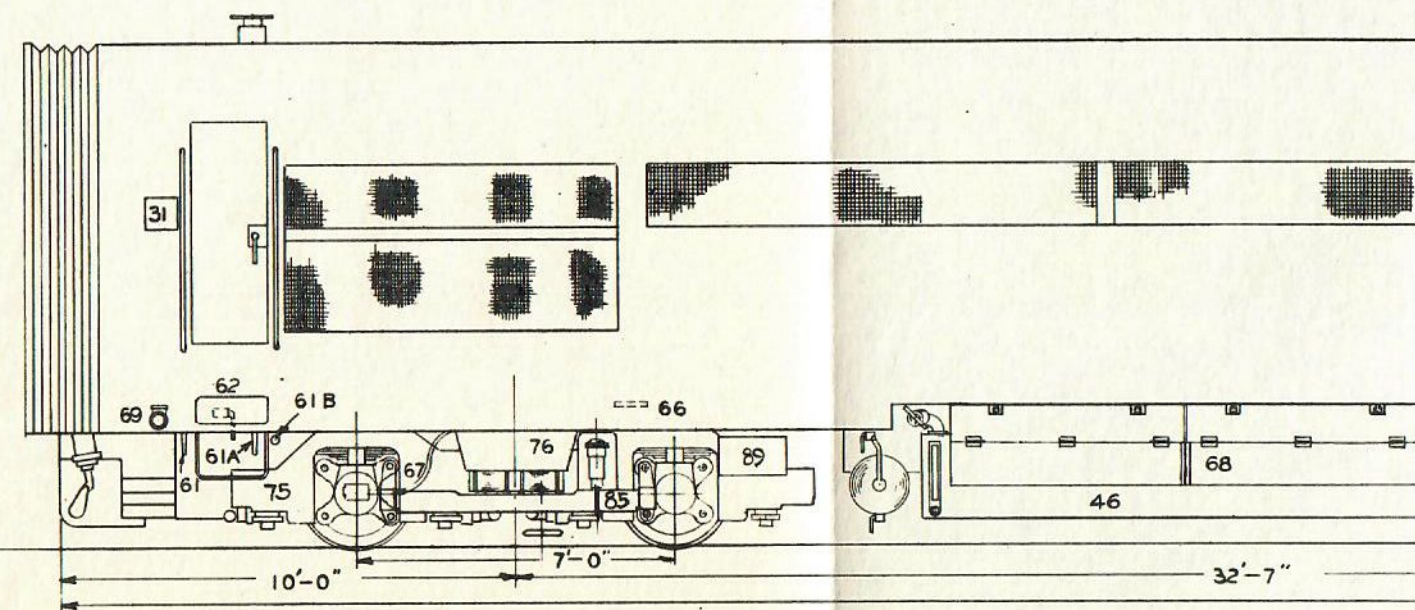
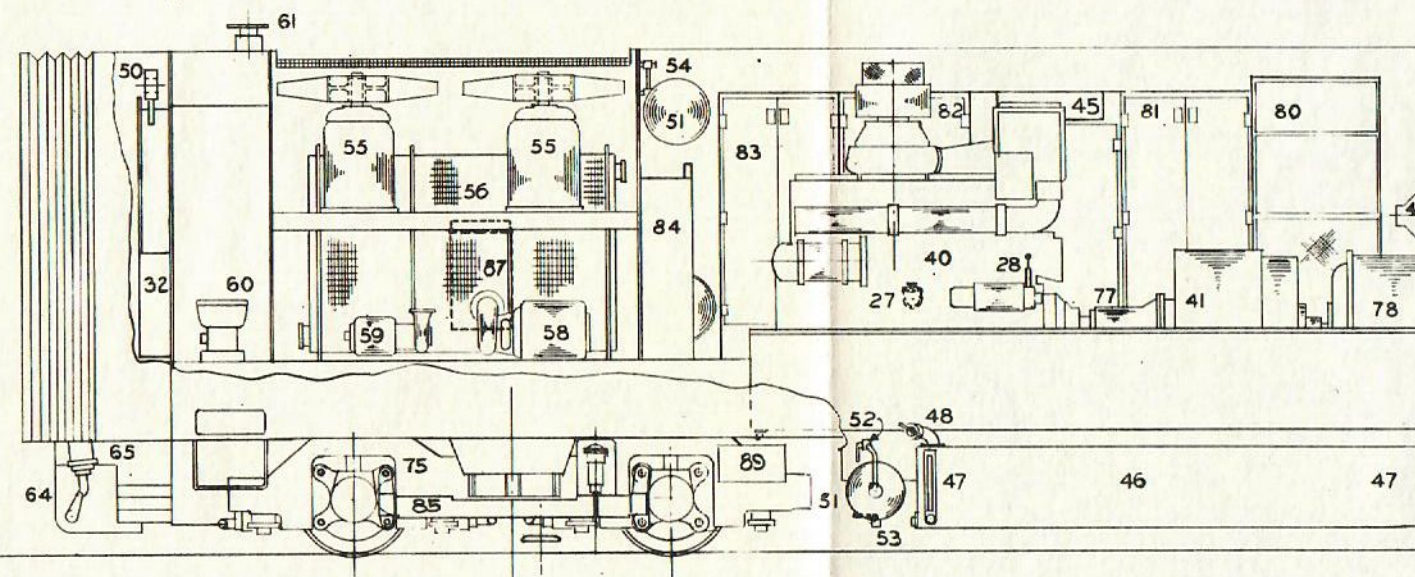
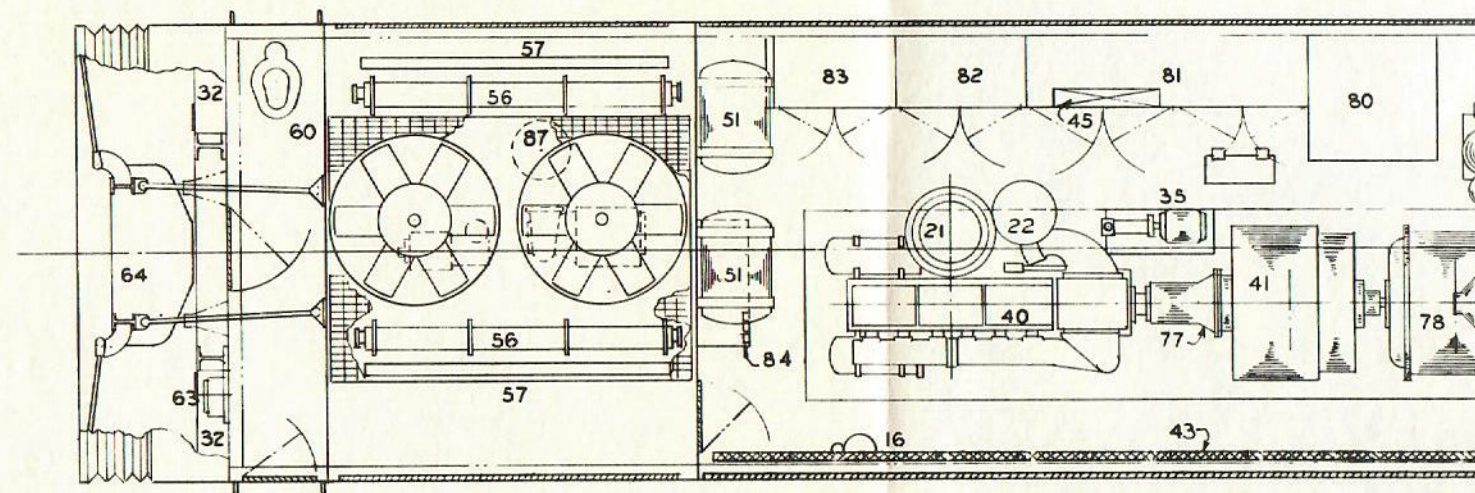


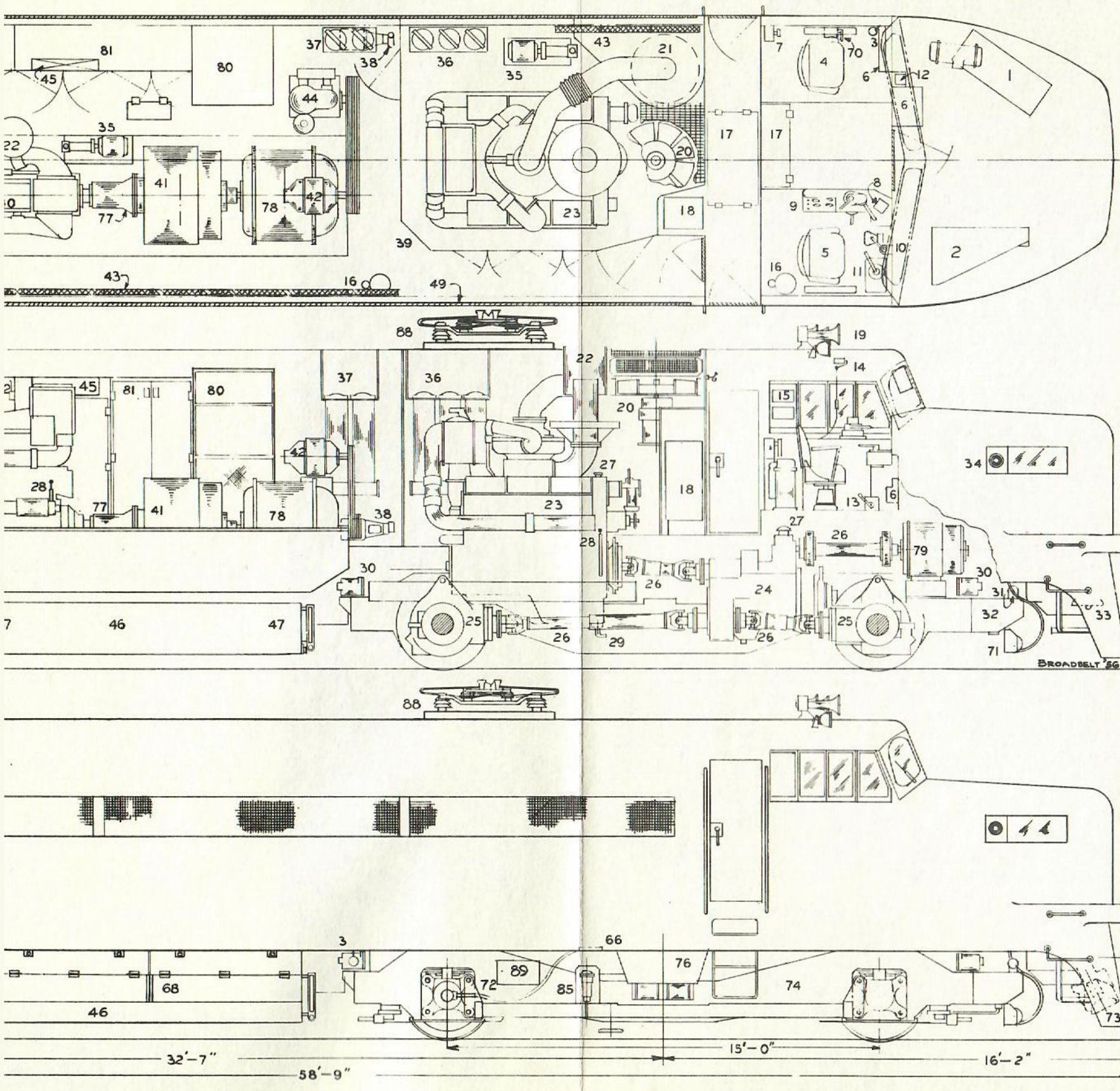


EXTERIOR DETAILS — TYPE MD-330 ENGINE

1. START LIMITATION ON R4G GOVERNOR
2. POSITIONING PIN
3. LUBE NIPPLES ON LINKAGE
4. ACTIVE GOVERNOR LEVER
5. CHECK VALVE
6. FLANGE CONNECTION FOR TACHOMETER GENERATOR
7. OIL LINE TO BUTTERFLY VALVE
8. GOVERNOR FOR BUTTERFLY VALVE
9. OIL LINE TO BUTTERFLY VALVE GOVERNOR
10. ADAPTER FOR TACHOMETER GENERATOR
11. OIL INLET TO GOVERNOR R4G FROM PRE-START PUMP
12. FLEXIBLE COUPLING
13. OIL CONNECTION FROM PRE-START PUMP
14. EXHAUST
15. COOLING WATER OUTLET FROM TURBOCHARGER
16. COOLING WATER OUTLET FROM CYLINDER HEADS
17. AIR LINE WITH CHECK VALVE
18. EXHAUST HEADER WITH INLET CONNECTION FOR TURBOCHARGER
19. TURBOCHARGER
20. TURBOCHARGER SUPPORT
21. GOVERNOR R4G
22. POINTER
24. PRESSURE REDUCING VALVE
25. OIL SLUDGE DRAIN PLUG
26. ENGINE COOLING WATER INLET
27. PRESSURE LINE TO SHUT-OFF DEVICE, PRE-START PUMP
28. VENT LINES
29. HEAT EXCHANGER FOR LUBE OIL
30. OIL LINE TO R4G GOVERNOR AND TO BUTTERFLY VALVE GOVERNOR
31. DRIP-OILER FOR TURBOCHARGER
32. LIFTING EYE FOR ENGINE
33. CLOSE-MESH OIL FILTER FOR CRANKSHAFT AND CONNECTING ROD BEARING LUBRICATION
34. FILTER CLEANING LEVER
35. AIR INTAKE PIPE
36. FUEL SUPPLY LINE
37. RETURN LINE
38. LEAK-OFF LINE
39. PLASTIC HOSE
40. DECOMPRESSION VALVES
41. FUEL DISTRIBUTOR
42. FUEL VENT SCREW
43. FUEL CONNECTION LINE
44. BUTTERFLY VALVE
45. LUBE OIL FILTER
46. OIL SLUDGE DRAIN LINE
47. COOLING WATER INLET TO HEAT EXCHANGER FOR PISTON COOLING OIL
48. OIL FILL
49. ELECTRIC STARTING MOTOR







1. Cab Signal Equip.
2. Air Brake Control Equip.
3. Emergency Fuel Cut Off.
4. Fireman's Seat
5. Engineer's Seat
6. Cab Heater
7. Hand Brake
8. Speed Indicator
9. Control Stand
10. Parking Brake Valve
11. Electro-Pneumatic Brake Valve
12. Cab Signal Ack. Whistle
13. Cab Signal Acknowledger
14. Horn Valve
15. Inspection Reports (R.S.)
16. Fire Extinguisher
17. Inspection Door (Transmission)
18. Water Cooler
19. Air Horn
20. Cooling—Supercharger Intercooler
21. Engine Air Filter—Oil Bath
22. Exhaust Stack
23. Propulsion Diesel Engine
24. Torque Converter Transmission
25. Axle Drive (with Disengaging Clutch)
26. Drive Shaft
27. Lube Oil Filler
28. Lube Oil Level Indicator
29. Lube Oil Drain
30. Brake Cylinder
31. Sand Fill
32. Sand Box
33. Bell
34. Number and Class Light
35. Pre-Lube Pump
36. Lube Filter (Main Engine)
37. Lube Filter (Aux. Engine)
38. Fuel Oil Transfer Pump
39. Propulsion Engine Compartment
40. Auxiliary Diesel Engine
41. Generator (AC)
42. Exciter
43. Air Filter Panels
44. Air Compressor
45. Elect. Instrument Panel
46. Fuel Oil Tank
47. Fuel Oil Gauge (R&L)
48. Fuel Oil Filler (R&L)
49. Grilles
50. Lifting Eyes
51. Air Reservoir
52. C.O. Cock
53. Drain Cock
54. Water Gauge (Expansion Tank)
55. Radiator Fan & Motor
56. Radiator Cores
57. Radiator Shutters
58. Water Pump (Main)
59. Water Pump (Aux.)
60. Toilet
61. Water Fill (Toilet)
- 61A. Water Fill (Engine System)
- 61B. Steam Line Conn. (Stand-by)
62. Supervisory Cut Out Cock
63. Back Up Light
64. Coupler (Train)
65. Coupler Operating Cylinder
66. Jacking Pad
67. Decelostat
68. Batteries (R&L)
69. Wayside Power Receptacle (R&L)
70. Cab Signal Changeover Switch
71. Cab Signal Receiver
72. Speed Indicator Drive
73. Type "E" Coupler
74. Power Truck
75. Idler Truck
76. Body Swing Links
77. Aux. Eng. Disengaging Clutch
78. Generator Driving Motor (3rd Rail)
79. Propulsion Driving Motors (3rd Rail)
80. Resistor Cabinet
81. M.U. and Third Rail Control Equip.
82. Train Power and Loco. Control Equip.
83. Battery Charging, Pump and Fan Control Equip.
84. Auxiliary Motor Speed Control Equip. Aux. Engine Gauge Panel
85. Third Rail Pick Up Arrgt.
86. Marker Lights
87. Immersion Heaters
88. Pantograph
89. Fuse Box

ARRANGEMENT OF EQUIPMENT, PROPULSION UNIT

